THE COSTS TO THE PETROLEUM INDUSTRY ASSOCIATED WITH MMT REMOVAL AND GRADE SPLIT CHANGES OF MOTOR GASOLINES

BY

Monenco Engineers and Constructors Inc.

FOR

Environmental Protection Service
Environment Canada

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ABSTRACT

This report details an investigation into the impact, on the Canadian refining industry in 1990, of the elimination of MMT antiknock additives in the unleaded grades of motor gasoline, and a change in gasoline grade split. A series of computerized process simulations was carried out covering refineries in the Atlantic, Quebec, Ontario, and Western Regions. For each of these regions, a composite refinery approach was used in which active refineries in the region were represented by a single entity whose major process unit capacities equalled the sum of the reported installed capacities in that region.

Estimated capital and operating costs for each region are presented as well as an overview of the current state of alternative fuels and blending processes.

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EXECUTIVE SUMMARY

The objective of this study was to estimate the additional capital investment and operating costs that would be incurred by the petroleum refining industry if MMT antiknock additive were withdrawn from use and the percentage of gasoline sales as leaded fuel were reduced from 30% to 10%. These changes are intended to reflect the maximum impact which adoption of U.S. 1981 auto emission standards could have on the refining industry.

The study was carried out using product demands, crude availabilities and product specifications as determined for 1990 by studies previously conducted for the Federal government by Hycarb Engineering. The only significant changes from the Hycarb study were the limiting of lead content in leaded gasoline to 0.29gm/litre maximum and adjustment of MMT use and gasoline grade splits to suit the situation being investigated.

Costs were determined for four separate cases as identified below:

(1) CGSB Octanes, 70/30 UL/L, with MMT.
(2) CGSB Octanes, 90/10 UL/L, without MMT.
(3) Market Octanes, 70/30 UL/L, with MMT.
(4) Market Octanes, 90/10 UL/L, without MMT.

Since current market octanes are considerably higher than minimum octane levels specified by the Canadian General Standards Board (CGSB), it was deemed important to investigate costs at these two extremes.

The petroleum refining industry was analyzed on a regional basis using a refinery simulator. A single refinery for each region having refinery capacity equal to the total refinery capacity in the regions (Atlantic, Quebec, Ontario, Western) was used to determine the refining modifications required (if any) for each case. It was assumed that all refineries currently in operation would continue to be in operation in 1990 with the exception of Texaco's Edmonton refinery for which closure in late 1984 has been announced. The approach adopted was to maximize utilization of existing equipment until such time that it could no longer meet requirements. Then new facilities (either isomerization or high severity reforming) could be chosen and the operation with the new facility was adjusted to minimize crude oil consumption. The severity of existing catalytic reformers was limited to 100 RON and reported capacities were discounted to allow operation at this severity.

Once the additional total new octane generating facilities for each region and each case had been determined, using the refinery simulator, each refinery in each region was reviewed to determine the appropriate allocation of new facilities to permit each refinery to produce specification product. The capital cost of new facilities was estimated using information from process licensors and Monenco experience. A 30% allowance was added to cover off-site costs. No account was taken of opportunities which may exist to revamp existing equipment, eliminate certain low octane components from the gasoline pool or purchase high octane blending components. These factors could, of course, reduce the capital cost of some cases but may increase operating costs.

Operating costs for each case were developed using available cost information for utilities, catalysts, chemicals, gasoline additives, maintenance, taxes, insurance, operating labour, crude oil, etc.

In 1984 dollars, the total incremental cost associated with MMT removal and grade split changes from 70/30 unleaded/leaded to 90/10 is estimated as follows. Costs given in this summary are total erected costs. An additional 30% has been added to capital costs contained in the body of this report to obtain a total erected cost.

	CGSB Octanes	Market Octanes
Capital Cost $M	305	494
Annual Operating Cost $M . . . (excluding taxes and capital charges)	26	42

The capital costs are scope costs with an accuracy of +/- 30%. No attempt has been made to analyze the impact that the required investment might have on the viability of certain refineries. Rather sufficient funds have been included to provide facilities to permit all existing refineries to manufacture specification product.

In the CGSB octane case, 10 of the 23 existing refineries required addition of isomerization facilities. In the market octanes case all 23 refineries required addition of isomerization facilities. In no case were facilities other than those associated with isomerization required. The increased crude oil required as a result of MMT removal and reduction of leaded gasoline sales was minimal with facilities provided and varied from 0.35% using CGSB octane to 0.22% using market octanes. The costs associated with this additional crude are included in the operating costs provided.

After completing the cases identified above four additional cases were studied to separate the cost of MMT removal and grade split changes. The four separate cases are identified below:

(1) CGSB octanes 70/30 UL/L without MMT
(2) CGSB octanes 90/10 UL/L with MMT
(3) Market octanes 70/30 UL/L without MMT
(4) Market octanes 90/10 UL/L with MMT

In 1984 dollars, the total incremental cost associated with MMT removal and grade split changes is estimated as follows. Costs given in this summary are total erected costs. An additional 30% has been added to capital costs contained in the body of this report to obtain a total erected cost.

	CGSB Octanes		MARKET Octanes	
	70/30 UL/L Without MMT	90/10 UL/L With MMT	70/30 UL/L Without MMT	90/10 UL/L With MMT
Capital cost $M	164	0	112	68
Operating cost $M (excluding taxes and capital charges)	8	11	12	19

In the CGSB octane 70/30 UL/L without MMT case 5 of the 23 existing refineries required addition of isomerization facilities. In the CGSB octane 90/10 UL/L with MMT case none of the 23 existing refineries required addition of isomerization facilities. In the market octane 70/30 UL/L without MMT case 9 of the 23 existing refineries required addition of isomerization facilities. In the market octane 90/10 UL/L with MMT case 7 of the 23 existing refineries required addition of isomerization facilities.

In no case were facilities other than those associated with isomerization required. The increased crude oil required as a result of MMT removal or reduction of leaded gasoline sales was minimal with facilities provided and varied from .25% using CGSB octanes to .33% using market octanes.

The costs associated with this additional crude are included in the operating cost provided.

1.0 INTRODUCTION

This report, prepared for Environment Canada, presents the results of a study into the costs to the petroleum refining Market arising from the removal of all MMT antiknock additives from unleaded grades of motor gasoline and a change in gasoline grade split by 1990.

Statistics on product demand, installed capacities of the major process units in the various refineries and typical composition of crude supplies were taken from Hycarb Engineering's report (Reference 14) which was supplied for the purposes of the study. For simplicity, the same general approach as used in the previous studies was adopted; that of dividing Canada into four regional areas and representing each by a single composite refinery which embodied the total installed capacity of the main processing units in each region.

In consultation with the client (EPS), (RON + MON)/2 was selected as the octane rating to be met at two levels. The first level termed "Market" octanes, matches that reported by Petroleum Association for the conservation of the Canadian environment (PACE.) A somewhat lower level selected by the client is referred to in the report as "CGSB" (Canadian General Standards Board) octanes. These octane specifications, as well as allowable concentrations for TEL and MMT additives to be used in the study, were established for each region (Table 1-1).

Using a computer model which simulates the general refinery scheme shown in Figure 2-1, base cases were first developed for the four regions. These represent the refinery conditions in each region with the given level of antiknock additives still in the gasoline. Leaded regular grade gasoline was taken to be 30% of the motor gasoline demand.

Comparative cases to determine the effect of eliminating MMT in the unleaded gasoline were then run using the same crude blend and, with one exception, the same product demand slate which was used in the corresponding base cases. In the zero MMT cases, while the total motor gasoline demands in each region were kept the same as the base cases, the proportion of leaded regular grade was reduced to 10% of the gasoline pool on the assumption that lead tolerant cars would not be produced for sale in Canada. Processing severities were adjusted and new octane improvement processes added as required until the octane levels of the gasoline produced were restored to those in the base cases.

Estimated capital and operating cost differentials are presented for each case.

The costs developed in the basic study are those required to meet the target octane levels. In the MMT free cases, no allowance was made for the loss of blending flexibility to avoid octane give away.

At the conclusion of the main study four additional cases were studied (using the same methodology as main report) and operating and capital costs identified. The octane specifications, as well as allowable concentrations for TEL and MMT additives used for these additional cases are presented in Table 8-1.

Simulation results, and operating and capital costs for these additional cases are presented separately in Section 8 of this report.

The base case used in the additional cases was that used for establishing incremental operating and capital cost for the main study.

TABLE 1 - 1

SUMMARY OF MOTOR GASOLINE

OCTANE SPECIFICATIONS & ANTIKNOCK ADDITIVE CONCENTRATIONS

	Government Octanes		Industry Octanes	
	Base	Case 1	Base	Case 1
Lead Concentration (Leaded Pool) Gms of Pb/L	0.29	0.29	0.29	0.29
MMT Concentration (Unleaded Pool) Mg of Mn/L	18.0	0	18.0	0
Gasoline Grade Split (Unleaded/Leaded)	70/30	90/10	70/30	90/10
Octane Specification (R+M/2)Min (Leaded/Unleaded Reg/Unleaded Prem)				
Atlantic	87/87/90	87/87/90	89.8/89/91.8	89.8/89/91.8
Quebec	87/87/90	87/87/90	89.8/89/91.8	89.8/89/91.8
Ontario	87/87/90	87/87/90	89.8/89/91.8	89.8/89/91.8
Western	85/85/88	85/85/88	88.3/88.3/90.8	88.3/88.3/90.8

2.0 METHODOLOGY

INTRODUCTION

This section discusses how the computer model was derived and used to simulate the various refinery processes necessary to produce products meeting the product slate and octane requirements.

The basis for the model is first described, followed by a description of the actual process involved in developing the simulated cases.

The section then continues with an account of the parameters used. Tables are included covering crude feedstocks, and product demands, as well as refinery operating parameters and product specifications.

The section concludes with an examination of the limitations of the modelling technique and how adjustments were made to ensure that results were not adversely affected by these limitations.

2.1 Description and Application of Computer Model

Owing to significant differences in the crude oil diets used by refineries, it was decided to divide Canada into four distinct regions namely Western, Ontario, Quebec and Atlantic. Figure 2-3 defines these regions geographically.

The computer model simulated the general refinery process unit configuration shown in Figure 2-1. Refinery operations in the four major regions of Canada were represented by single composite refineries representing each region. The capacity of each process unit in the regional composite refinery was taken to equal the sum of the 1990 installed capacities of all similar units within that region as shown in Hycarb Engineering's report (Reference 14).

The computer model simulates each unit in the refinery and calculates overall material balance and product properties but does not incorporate economic data. In preparing study cases, the model was solved iteratively by user interaction. In effect, the optimizing procedure usually performed by a sub-routine algorithm was done manually.

The optimizing criteria applied for each case study were:-

a) Maximum utilization of existing process units.
b) Minimum crude oil consumption.

Incremental crude oil consumption is disadvantageous to Canada both economically and politically and thus was considered to be the prime factor in the determination of the optimal solution.

A systematic approach was used to develop each case. The steps followed are illustrated in Figure 2-2 and summarized below:

1. Data gathering. Each case study required a definition of feedstock diets, slates, and unit capacities for each region. These are shown in Tables 2-1 to 2-12.

2. Execution of the crude blending routine (blocks 1-3 in Figure 2-2). This computer routine breaks down the individual crude feedstocks into pseudocomponents and blends them in the specified proportions.

3. Execution of material balance routine (blocks 4-10 in Figure 2-2). Sufficient data to satisfy the material balance was entered, such as product slates, feed rates to units, TBP cut points and operating severities for the individual units etc. The program then executes to produce estimated yields from the process.

4. Inspection of material balance results (block 11 in Figure 2-2. The results are reviewed against the following constraints:

    a) unit capacities (Tables 2-9 to 2-12);

    b) limitations in operating variables such as cut points and unit turndowns (Table 2-13).

    If these constraints are not satisfied, step 3 is repeated with modified input data.

5. Execution of product quality routine (blocks 12 and 13). Additional data (including gasoline lead concentration) is entered and product qualities are then computed.

6. Inspection of product qualities (block 14). The calculated product qualities are reviewed against the product specifications listed in Table 2-14. If the specifications are not satisfied, the program is returned to either step 3 or 5 as desired for adjustment.

7. Review of optimizing criteria. If a solution is found to satisfy all the constraints, it is then reviewed to ensure that it is satisfactory in terms of the optimizing criteria previously mentioned. In general, cases were repeated until one or more discrepancies between a variable and its constraints were eliminated.

In this manner eight Base Cases were developed for each region, using 1.24 cc of TEL/IG (equivalent to 0.29 grams of lead/litre) in leaded regular gasoline and 18 milligrams of MMT/litre in unleaded regular and unleaded premium grades. The eight base cases were made up of four (one in each region) aimed at 1990 Market target levels, as developed by PACE and four at the slightly lower CGSB octane levels. For all the base cases the leaded regular grade was set at 30% of total motor gasoline.

Alternates to each base case were then developed using 1.24 cc of TEL/IG in leaded regular gasoline and 0 MMT in unleaded gasoline. Product slates and target octane numbers were unchanged except that the volume of leaded regular grade was reduced to 10% of the total pool. The unleaded premium was left the same and the unleaded regular increased to maintain total volume. The following table shows the 1990 targets.

TARGET OCTANE LEVELS -(RON + MON)/2

ALL REGIONS

	Leaded Regular	Unleaded Regular	Unleaded Premium
Market	89.0	89.0	91.8
CGSB	87.0	87.0	90.0

In keeping with the two optimization criteria, each case was first run using existing equipment and adjusting Reformer severity up to 100 RON if necessary, to balance the gasoline pool octane requirements. The isomerization unit during this stage was 100% by-passed.

If the octanes could not be met with existing equipment once through isomerization of the C5 - 170DEG.F LSR was added. The conversion losses with isomerization are less than those for reforming. A minimum crude run was then obtained by operating the isomerization unit at full capacity and adjusting Reformer severity to balance the octane requirements. At the higher Market octane levels, Reformer severity could only be reduced to that required to blend the unleaded premium. At this point, if the pool octane was still too high, the isomerization unit by-pass was increased until balance was obtained.

Total isomerization was added in those cases where once through isomerization and 100 RON Reformate would not meet requirements. The approach to total isomerization was the same as that previously described for once through isomerization.

Isomerization was selected in preference to adding new higher severity reforming capacity (>100RON), because, when compared with reforming it offers very little loss in yield which results in significantly lower crude runs for the equivalent amount of octane improvement.

2.2 Basic Parameters

Crude Diets (Tables 2-1 to 2-4)

The 1990 feedstock diets for each region were developed from types shown to be available in Hycarb Engineering's report (Reference 14). For simplification, the qualities of the mix for each region were blended from the light and heavy crude types already built into the program file. Frontier crude was assumed to be equivalent to Venezuelan Light.

Since the computer model does not include simulation of residual reduction processes such as visbreaking or coking, sufficient extra syncrude quality stock was added to the mix to produce an acceptable Heavy Fuel Oil viscosity. Provision of residual reduction processes was considered to be outside the scope of the study.

The individual crudes listed in Tables 2-1 to 2-4 are actually blends of several crudes from different fields. The specific assays used to represent each blend are summarized in Table 2-15. Assays for the domestic crudes were taken from in-house reference files while assays for the imported crudes were taken from the Oil and Gas Journal (Reference 4 and 5).

Product Slates (Tables 2-5 to 2-8)

Product demands as set out in Hycarb Engineering's report (Reference 14) were used as 1990 production figures for each region. Refinery output is reported for total gasoline rather than for each grade. The production of leaded regular grade was taken to be 30% of total gasoline in all cases using MMT and 10% of total in those cases with MMT removed.

Refinery Configurations (Tables 2-9 to 2-12)

Capacities for the major processing units installed in each refinery as of the end of 1983 were obtained from Hycarb Engineering's report (Reference 14). Reforming capacities are down rated to reflect the assessed capacities at 98 RON.

Refinery Operating Parameters (Table 2-13)

These constraints were based on in-house experience and reference files pertaining to refinery design and operation.

Production Specifications (Table 2-14)

The number of product types was minimized and their specifications were derived using an average of the specifications for the range of grades of products within a particular broad category.

The specifications published by the Canadian CGSB Standards Board were supplemented by additional data on product quality attained in practice and appropriate target levels which were available from both in-house references and the major refiners themselves.

Process Yields

Catalytic reformer, catalytic cracker and isomerization yields were taken from "Petroleum Refining Technology and Economics" (Reference 3). In general these correlations are based on feedstock gravity and appropriate characterization factors derived from the crude assay data.

The following assumptions were made regarding process unit types and appropriate data was incorporated into the computer model.

Catalytic Reformer - Mono-metallic platinum catalyst semi-regenerative unit.

Catalytic Cracker - FCC unit using zeolite catalyst and heavy vacuum gas-oil feedstock.

Alkylation - HF catalyst using C3/C4 olefinic feedstock plus i-C4.

Isomerization - LSR (C5- 170 DEG. F) feedstock both once through and total recycle.

For the HF Alkylation Unit, iso-butane requirements were taken to be 1.24 volumes per volume of olefin, with iso-butane being imported as required to react all olefins allocated to alkylation.

It was assumed that the gas plant in each composite refinery had the capability to recover 95% iso-butane for alkylation and total C4's for blending as required from all sources (crude tower overhead, catalytic Reforming, Catalytic cracking).

For the Distillate Desulphurization Units, hydrogen consumption estimates were taken from Hydrocarbon Processing (August, 1980). The consumptions used for the various streams are as follows:

Naphtha/LSR : 30 SCF/bbl
Kerosene : 200 SCF/bbl
Light Gas Oil and Light Cycle Oil : 700 SCF/bbl

Operating Costs (Table 2 - 17)

The 1984 costs for feedstocks and products were obtained from Energy Mines & Resources (E.M.R.) and from current publications.

Utility costs were developed from discussions with suppliers and in-house information.

Energy Penalty

The definition of the energy penalty incurred in manufacturing gasoline in any one of the study cases, as compared with the base case, was derived as follows.

1. Energy penalty (as a percentage) equals the differential operating energy requirement times 100 divided by the energy content of the base case crude oil consumption.

2. Differential operating energy requirement equals the study case operating energy requirement minus the base case operating energy requirement.

Expressed in terms of a mathematical equation, this definition reduces to the following:

$$\text{Energy Penalty} \qquad \frac{Es - Eb \times 100}{Hb}$$

where Es = operating energy requirement of study case,

Eb = operating energy requirement of base case,

Hb = energy content of crude oil used in base case.

If all three are expressed in BTU/calendar day (CD), then

$$Hb = \text{Imp. gallons used/CD} \times \text{HHV (BTU/Imp. gallon)}$$

$$\text{and HHV} = [18320 + 40\,(\text{API} - 10)] \times 10 \times \text{S.G.}$$

Table 2-18, which lists the unit energy requirement for process unit operations, was applied in the calculations. This data was derived from a literature search and a representative number assigned to each process unit considered.

Energy equivalents of utilities which were applied are listed below:

Electricity	10000	BTU/KW
Steam	1300	BTU/LB
Fuel		HHV *
Heavy Fuel Oil (#6)		HHV calculated for each case by formula
Crude Oil		HHV calculated for each region by formula (e.g. BTU/I.G. for Quebec)

* N.B.: The basis for FOE of Fuel Gas Product in the computer model is 6.35×10^{6} BTU/BBL.

Product Quality Estimate

A pseudocomponent approach was used to estimate the properties of distillates, turbo fuels and heavy fuel oil. In this approach the true boiling point curve for each crude was subdivided into pseudocomponents of 20 degrees F boiling range. Each of these was assigned a specific gravity, mid-boiling point and sulphur content as specified by the crude assay. Using procedures provided in the API Data Book (Reference 6), the pseudocomponent composition of each product was used to estimate ASTM distillations, specific gravities and characterization factors. These in turn were used to estimate product qualities such as viscosity, flash point, and pour point, based on various published and in-house correlations. In particular, the diesel cetane index was estimated using the ASTM calculation procedure (Reference 7). The pseudocomponent approach was not used for estimating gasoline properties. Table 2-16 summarizes the RVP and RON used for each gasoline component. The RON values shown are in line with recently published figures (Reference 8). Octane blending, including the effect of lead additives, was based on a method by Eastman (Reference 9). RVP's for each gasoline grade were obtained by blending on a molar basis.

2.3 Assumptions And Limitations

In any empirical study the limitations of the parameters and methods used must be recognized and appropriate steps taken to eliminate, or at least mitigate, their effect on the results. In this study the typical refinery model (Figure 2.1) does not contain all the processing units found in individual refineries, nor does it contain as much processing and blending flexibility. To compensate for these factors a number of assumptions were made, as discussed in this section.

In reviewing the results of the study, it must be remembered that the effects of most, if not all, of these assumptions tend to cancel out when going from the base cases with MMT to the alternate cases without MMT. Therefore, the shortfall of processing to meet the selected unleaded motor gasoline octane targets is considered to be realistic.

Composite Refinery

The composite refinery approach assumes that all the refineries in each region are operating identically at constant conditions throughout the year. In reality, individual refineries may deviate significantly from the composite model in terms of processing schemes, process yields, feedstock and product slates. The operation of a refinery may also change considerably as a result of changed feedstock or seasonal changes in product demand. The following assumptions related to the crude unit are of particular significance.

(a) The cut point between LSR (light straight run) and Reformer feed was taken at 170 FVT. This leaves benzene and cyclohexane in the Reformer feed while yielding a C5 - 170 F cut for isomerization which contains the low octane C6 components. It was assumed that existing fractionation equipment was not adequate to provide sufficient separation between the LSR and Reformer feed to realize the optimum selectivity from both processes. Allowance has been made for new naptha splitters as part of the cost of the isomerization units.

(b) The model assumes only one light gas oil sidestream. Many refineries produce light and heavy atmospheric gas oil streams, which would enhance blending flexibility in the distillate pool.

The target kerosene EP was taken at 560 FVT to suit stove oil distillation limits and the LGO end point was set at 660 FVT as a suitable average for diesel quality.

For heavy vacuum gas oil, 1050 FVT end point was taken to be a suitable average between that required for asphalt operation and that for maximum yield. Since heavy vacuum gas oil includes heavy atmospheric gas oil, a 25-30% reduction in vacuum unit feed can be used to determine the required vacuum distillation capacity.

Other Processes

Hydrocracking

Hydrocracking and catalytic cracking capacity were added and the hydrocracker feed run through the catalytic cracker. Thus the hydrocracking yields and product quality are assumed to be identical to those from catalytic cracking. To this end the LCO shown being blended to diesel may be considered to be from the hydrocracker(s). It is also assumed that the pool octane from the cat gasoline plus the additional polymer or alkylate in the cat cracker from the hydrocracker feed is equivalent to the product from catalytic reformed heavy hydrocrackate plus the light naphtha from the hydrocracker.

Coking and Visbreaking

These processes are not represented. The effect of these processes was simulated by adding enough syncrude or additional syncrude into the crude mix to produce an HFO of suitable viscosity. In effect the syncrude represents the net overhead products from residual reduction.

Aromatics

In Quebec the quantity of aromatics in total aromatics, naphtha specialties and naphtha to petrochemical feed is assumed to be equivalent to reformate and is deducted from the reformate produced. In Ontario the naphtha specialties including aromatics are approximately of reformate quality and are also deducted from reformate yield. In the Western region there is not enough extraneous naphtha product to balance the aromatic requirement. In order to compensate for the extraction of the quantity of aromatics required for petrochemicals and also for the higher octanes required on the West coast, the target octanes for motor gasoline in the Western region were left at the same level as the Eastern regions rather than at the normal lower level for the Prairies.

Asphalt

All asphalt was assumed to be produced as residuum from the vacuum tower. No adjustment was made for cutback quantities, etc. due to lack of information.

Product Specifications

The following assumptions were made relating to the product specifications.

a) Due to the lack of published production figures, different product grades of light fuel oil, diesel fuel and heavy fuel oil were not considered. The specifications given in Table 2-14 are representative of the several grades of these products.

b) Not all of the specifications stipulated by the CGSB of Canada for each product could be considered due to unavailability of adequate quality estimation correlations. However, some additional specifications taken from in-house refinery planning data were included in the list of specifications.

Catalytic Reforming Capacity

Certain assumptions were necessary relating to the throughput/severity capacity of existing reformers, as discussed below.

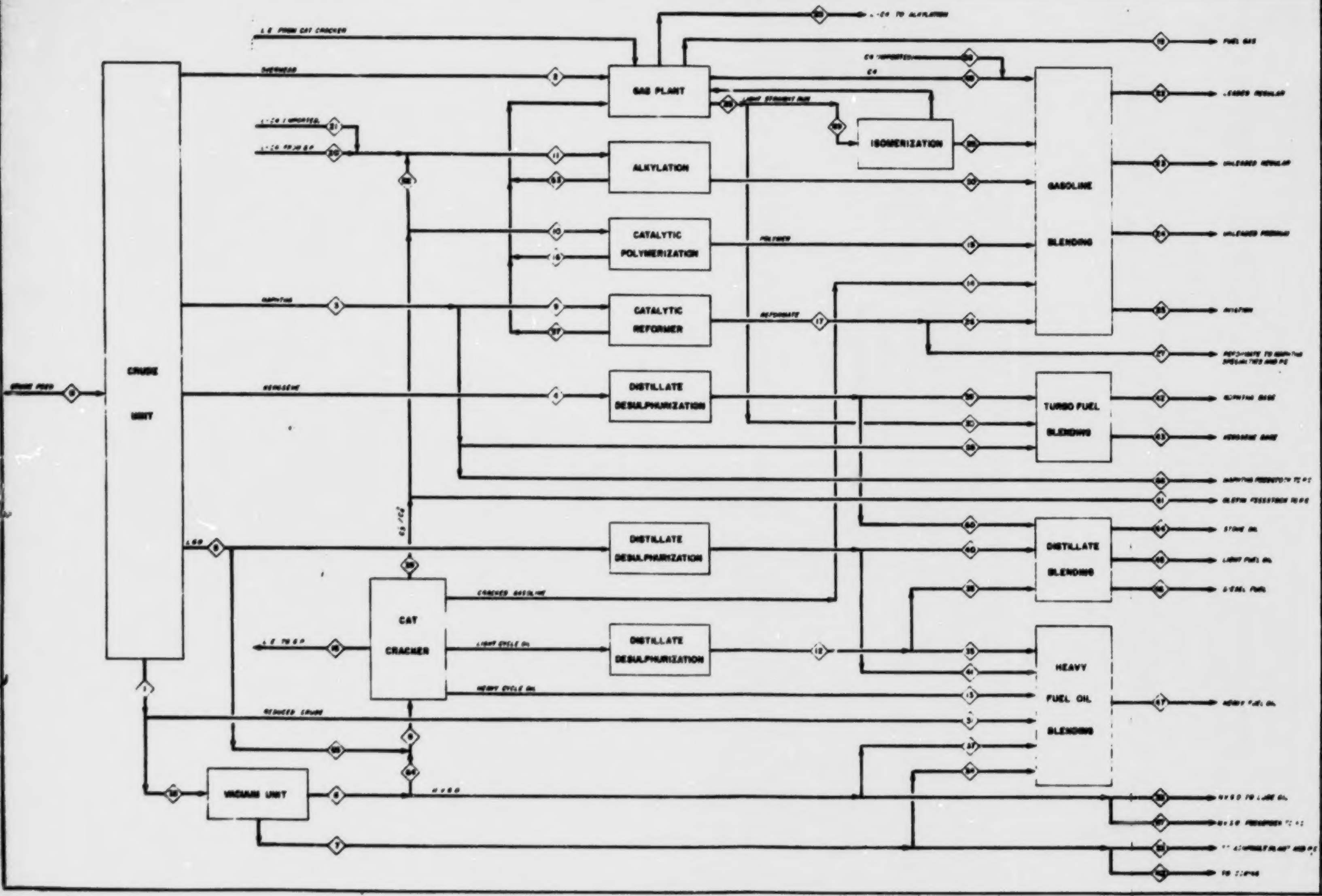
In respect of the 1983 installed reformer capacity, it should be appreciated that most of the reformer units in Canada are old, semi-regenerative types. The required clear octane levels of the gasoline pools during the past ten years have risen steadily due to the gradual introduction of unleaded grades and the trend to reduce the lead additive usage in gasoline. Reformer severities in 1983, expressed in terms of RON, generally ranged from 95 to 98. The trend of increasing proportions of unleaded grades in the total gasoline pools has meant that existing reformer units are being "stretched" to operate at ever increasing severities.

There are several methods to "stretch" or modify a catalytic reforming unit. Some refiners have replaced the mono-metallic catalyst with an expensive bi-metallic catalyst and, in consequence, have gained the advantages of increased catalyst life and improved reformate yields while retaining high operating pressures. A few refiners have performed major modifications to existing units to convert them to cyclic regeneration types. These modifications allow the units to operate at severities of around 100 RON or higher. Operation of unmodified existing units at higher severities would induce both capacity and mechanical constraints on the systems and also significantly reduce catalyst life.

alistic basis for the study, the reforming capacity of the various regions was rated as follows.

	Installed Capacity		Rated Capacity	
Region	BPCD Semi-Regen.	BPCD Cyclic	BPCD 98 RON	BPCD 100 RON
Atlantic	39,000	8,200	37,400	30,100
Quebec	85,500	0	77,000	57,700
Ontario	106,100	15,900	111,400	87,500
Western (Prair.)	62,300	20,800	76,800	62,800
Western (B.C.)	23,300	0	17,500	13,100
Western (Total)	85,600	20,800	94,300	75,900

None of the existing units was considered capable of 103 RON severity and entirely new units would have to be built to reach this level.


CRUDE FEED
CRUDE UNIT
OVERHEAD
NAPHTHA
KEROSENE
L.G.O.
REDUCED CRUDE
VACUUM UNIT
H.V.G.O.
L.E. FROM CAT CRACKER
L-C4 IMPORTED
L-C4 FROM G.P.
GAS PLANT
LIGHT STRAIGHT RUN
ALKYLATION
CATALYTIC POLYMERIZATION
CATALYTIC REFORMER
DISTILLATE DESULPHURIZATION
DISTILLATE DESULPHURIZATION
DISTILLATE DESULPHURIZATION
ISOMERIZATION
CAT CRACKER
L.E. TO G.P.
CRACKED GASOLINE
LIGHT CYCLE OIL
HEAVY CYCLE OIL
POLYMER
REFORMATE
C4 IMPORTED
C4
L-C4 TO ALKYLATION
GASOLINE BLENDING
TURBO FUEL BLENDING
DISTILLATE BLENDING
HEAVY FUEL OIL BLENDING
FUEL GAS
LEADED REGULAR
UNLEADED REGULAR
UNLEADED PREMIUM
AVIATION
REFORMATE TO NAPHTHA SPECIALTIES AND PC
NAPHTHA BASE
KEROSENE BASE
NAPHTHA FEEDSTOCK TO PC
OLEFIN FEEDSTOCK TO PC
STOVE OIL
LIGHT FUEL OIL
DIESEL FUEL
HEAVY FUEL OIL
HVGO TO LUBE OIL
HVGO FEEDSTOCK TO PC
TO ASPHALT PLANT AND PC
TO COKING

LEGEND

H.V.G.O. HEAVY VACUUM GAS OIL

L.G.O. LIGHT GAS OIL

L.E. LIGHT ENDS
(C4 AND LIGHTER)

G.P. GAS PLANT

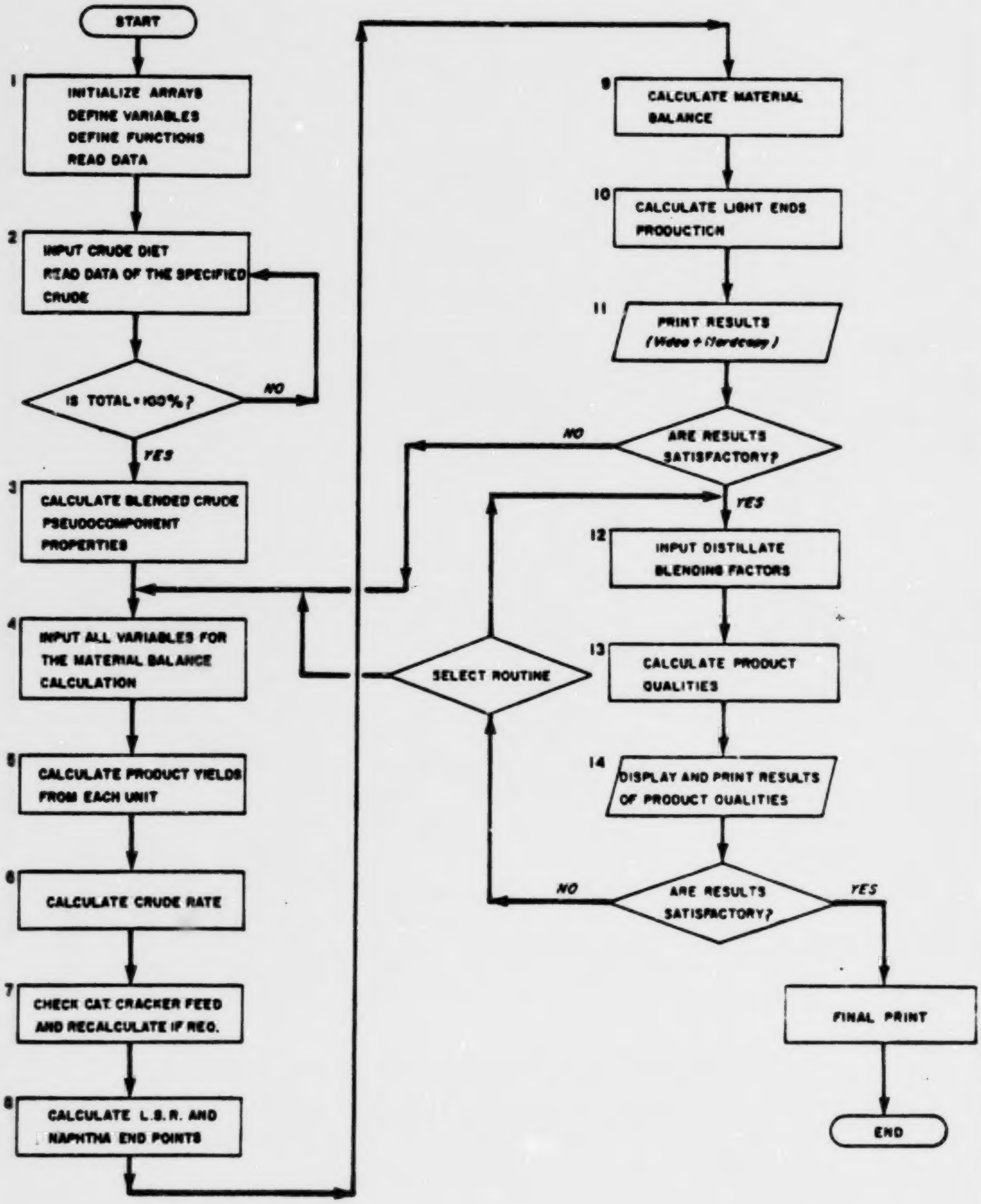
F.G. FUEL GAS

P.C. PETROCHEMICAL PLANT

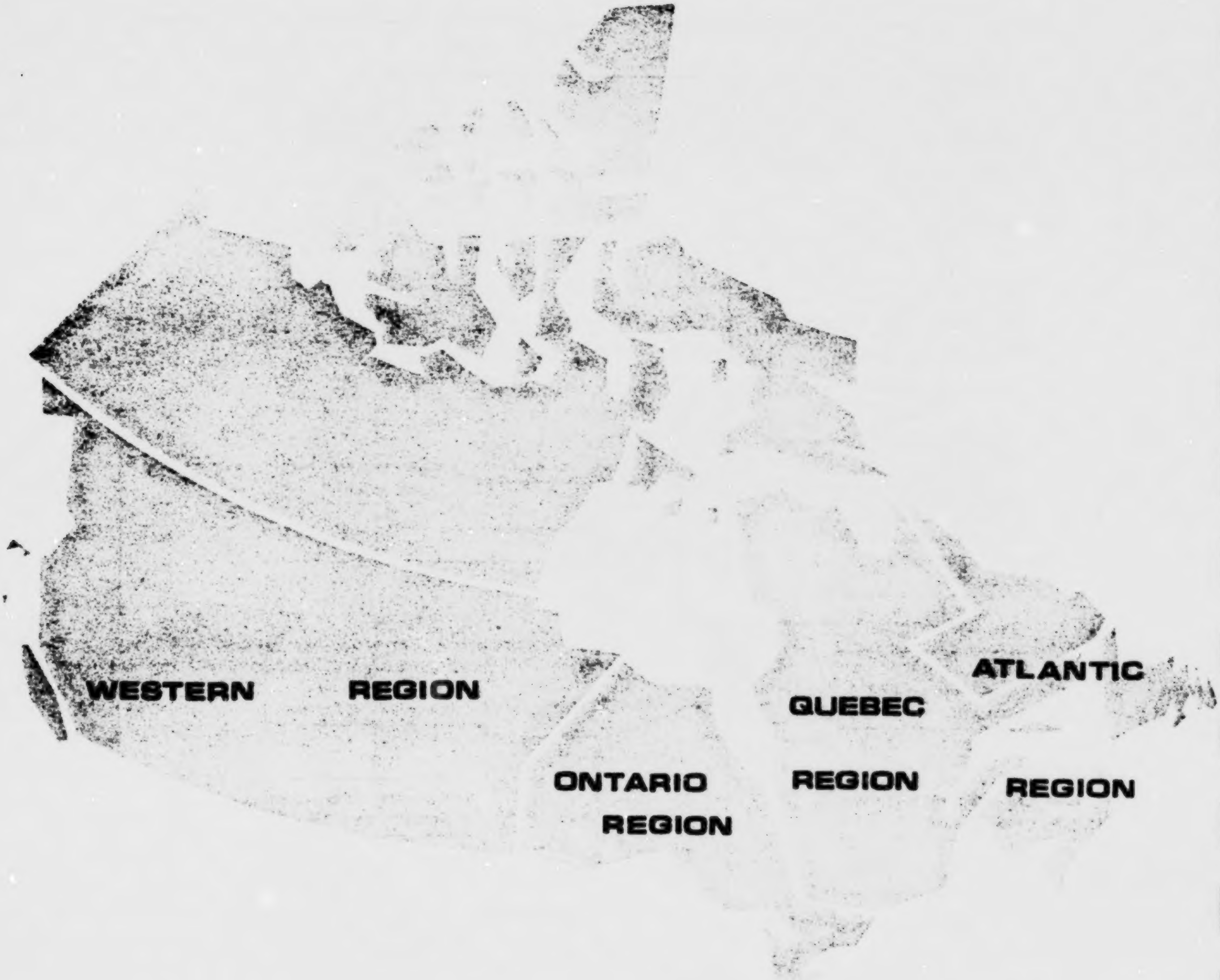
◇ STREAM I.D. No. ON COMPUTER PRINTOUTS

Fig.2.1

BLOCK FLOW DIAGRAM OF REFINERY MODEL


START
1
INITIALIZE ARRAYS
DEFINE VARIABLES
DEFINE FUNCTIONS
READ DATA
2
INPUT CRUDE DIET
READ DATA OF THE SPECIFIED CRUDE
IS TOTAL = 100%?
NO
YES
3
CALCULATE BLENDED CRUDE PSEUDOCOMPONENT PROPERTIES
4
INPUT ALL VARIABLES FOR THE MATERIAL BALANCE CALCULATION
5
CALCULATE PRODUCT YIELDS FROM EACH UNIT
6
CALCULATE CRUDE RATE
7
CHECK CAT. CRACKER FEED AND RECALCULATE IF REQ.
8
CALCULATE L.S.R. AND NAPHTHA END POINTS
9
CALCULATE MATERIAL BALANCE
10
CALCULATE LIGHT ENDS PRODUCTION
11
PRINT RESULTS
(Video + Hardcopy)
ARE RESULTS SATISFACTORY?
NO
YES
12
INPUT DISTILLATE BLENDING FACTORS
SELECT ROUTINE
13
CALCULATE PRODUCT QUALITIES
14
DISPLAY AND PRINT RESULTS OF PRODUCT QUALITIES
ARE RESULTS SATISFACTORY?
NO
YES
FINAL PRINT
END

FLOWCHART FOR REFINERY SIMULATION FIG. 2-2


WESTERN REGION
ONTARIO REGION
QUEBEC REGION
ATLANTIC REGION

DEFINITION OF REGIONS IN CANADA Figure 2·3

TABLE 2-1

ATLANTIC REGION

CRUDE DIET 1990

	LV%
Frontier	33.0
Venezuelan	7.0
Arabian Light	30.6
Mexican Light	9.9
North Sea	4.5
Syncrude	15.0
TOTAL	100.0

Average Blend

Gravity,DEG. API	31.6
Sulphur, Wt. %	1.2

TABLE 2-2

QUEBEC REGION

CRUDE DIET 1990

	LV%
Frontier	16.8
Venezuelan Heavy	11.65
Arabian Heavy	6.95
Mexican Heavy	11.65
Canadian Heavy	27.3
Syncrude	16.3
Condensate	9.4
TOTAL	100.0

Average Blend

Gravity, DEG. API	28.5
Sulphur Wt. %	1.81

TABLE 2-3

ONTARIO REGION

CRUDE DIET 1990

	LV%
Canadian Light	49.0
Canadian Heavy	9.2
Syncrude	30.8
Condensate	11.0
TOTAL	100.0

Average Blend

Gravity, DEG. API	36.8
Sulphur, Wt.%	0.48

TABLE 2-4

WESTERN REGION

CRUDE DIET 1990

	LV %
Canadian Light	65.1
Syncrude	31.5
Condensate	3.4
TOTAL	100.0

Average Blend

Gravity, DEG.API	36.1
Sulphur, Wt. %	0.31

TABLE 2-5

ATLANTIC REGION

TOTAL PRODUCT SLATE FOR 1990

	Base Cases		Alternate Cases	
	(70/30 Split)		(90/10 Split)	
	BPCD	LV%	BPCD	LV%
Liquid Petroleum Gases	3,019	2.27	3,019	2.27
Leaded Regular Gasoline	12,580*	9.46	4,195**	3.16
Unleaded Regular Gasoline	26,418	19.87	34,803	26.18
Unleaded Premium Gasoline	2,956	2.22	2,956	2.22
Aviation Gasoline	0	0	0	0
Naphtha Specialties	0	0	0	0
Olefin Petrochemical Feed	0	0	0	0
Naphtha Petrochemical Feed	1,348	1.01	1,348	1.01
Jet Fuel B	1,761	1.32	1,761	1.32
Jet Fuel A	4,403	3.31	4,403	3.31
Stove Oil	2,390	1.80	2,390	1.80
Diesel Fuel	27,991	21.07	27,991	21.07
Light Fuel Oil (#2)	26,607	20.02	26,607	20.02
Heavy Fuel Oil (#6)	13,901	10.46	13,901	10.46
Lube Oil	63	.05	63	.05
Asphalt	9,498	7.14	9,498	7.14
Total Product	132,935	100.00	132,935	100.00

* 30% of Gasoline
** 10% of Gasoline

TABLE 2-6

QUEBEC REGION

TOTAL PRODUCT SLATE FOR 1990

Product	Base Cases (70/30 Split) BPCD	Base Cases (70/30 Split) LV%	Alternate Cases (90/10 Split) BPCD	Alternate Cases (90/10 Split) LV%
Liquid Petroleum Gases	4,780	1.83	4,780	1.83
Leaded Regular Gasoline	26,456*	10.10	8,820**	3.37
Unleaded Regular Gasoline	53,805	20.55	71,441	27.28
Unleaded Premium Gasoline	7,925	3.03	7,925	3.03
Aviation Gasoline	698	.27	698	.27
Naphtha Specialties	10,630	4.06	10,630	4.06
Olefin Petrochemical Feed	0	0	0	0
Naphtha Petrochemical Feed	6,919	2.64	6,919	2.64
Jet Fuel B	3,585	1.37	3,585	1.37
Jet Fuel A	11,133	4.25	11,133	4.25
Stove Oil	1,384	.53	1,384	.53
Diesel Fuel	36,545	13.96	36,545	13.96
Light Fuel Oil (#2)	20,505	7.83	20,505	7.83
Heavy Fuel Oil (#6)	55,901	21.34	55,901	21.34
Lube Oil and Gas Oils	6,101	2.33	6,101	2.33
Asphalt	15,473	5.91	15,473	5.91
Total Product	261,840	100.00	261,841	100.00

* 30% of Gasoline
** 10% of Gasoline

TABLE 2-7

ONTARIO REGION

TOTAL PRODUCT SLATE FOR 1990

	Base Cases		Alternate Cases	
	(70/30 Split)		(90/10 Split)	
	BPCD	LV%	BPCD	LV%
Liquid Petroleum Gases	3,711	.87	3,711	.87
Leaded Regular Gasoline	51,175*	10s2.00	17,058**	
Unleaded Regular Gasoline	104,062	24.40	138,179	32.40
Unleaded Premium Gasoline	15,348	3.60	15,348	3.60
Aviation Gasoline	126	.03	126	.03
Naphtha Specialties	22,581	5.29	22,581	5.29
Olefin Petrochemical Feed	0	0	0	0
Naphtha Petrochemical Feed	15,285	3.58	15,285	3.58
Jet Fuel B	4,277	1.00	4,277	1.00
Jet Fuel A	19,625	4.60	19,625	4.60
Stove Oil	2,264	.53	2,264	.53
Diesel Fuel	81,959	19.23	81,959	19.23
Light Fuel Oil (#2)	38,243	8.97	38,243	8.97
Heavy Fuel Oil (#6)	33,274	7.80	33,274	7.80
Lube Oil and Gas Oils	26,167	6.14	26,167	6.14
Asphalt	8,366	1.96	8,366	1.96
Total Product	426,463	100.00	426,463	100.00

* 30% of Gasoline
** 10% of Gasoline

TABLE 2-8

WESTERN REGION

TOTAL PRODUCT SLATE FOR 1990

	Base Cases		Alternate Cases	
	(70/30 Split)		(90/10 Split)	
	BPCD	LV%	BPCD	LV%
Liquid Petroleum Gases	12,706	2.62	12,706	2.62
Leaded Regular Gasoline	60,195*	12.43	20,065**	4.14
Unleaded Regular Gasoline	126,555	26.13	166,685	34.42
Unleaded Premium Gasoline	13,901	2.87	13,901	2.87
Aviation Gasoline	2,579	.53	2,579	.53
Naphtha Specialties	6,982	1.44	6,982	1.44
Olefin Petrochemical Feed	0	0	0	0
Naphtha Petrochemical Feed	377	.08	377	.08
Jet Fuel B	20,883	4.31	20,883	4.31
Jet Fuel A	17,109	3.53	17,109	3.53
Stove Oil	5,913	1.22	5,913	1.22
Diesel Fuel	157,816	32.59	157,816	32.59
Light Fuel Oil (#2)	13,398	2.77	13,398	2.77
Heavy Fuel Oil (#6)	24,342	5.03	24,342	5.03
Lube Oil and Gas Oils	5,472	1.13	5,472	1.13
Asphalt	16,065	3.32	16,065	3.32
Total Product	484,293	100.00	484,293	100.00

* 30% of Gasoline
** 10% of Gasoline

TABLE 2-9

ATLANTIC REGION

INSTALLED REFINERY PROCESS UNIT CAPACITIES

UNIT TYPE		BPCD
Crude Distillation		340,000
Vacuum Distillation		109,000
Catalytic Reforming,	Installed	47,200
	98 RON rated	37,400
	100 RON rated	30,100
Catalytic Cracking		76,700*
Distillate Desulphurization		94,300
Polymerization		4,400 (Product)
Alkylation		0
Isomerization C-5/C-6		0

*Includes 30,200 BPCD Hydrocracking

TABLE 2-10

QUEBEC REGION

INSTALLED REFINERY PROCESS UNIT CAPACITIES

UNIT TYPE	BPCD
Crude Distillation	422,000
Vacuum Distillation	176,000
Catalytic Reforming, Installed	85,500
98 RON rated	77,000
100 RON rated	57,700
Catalytic Cracking	119,000*
Distillate Desulphurization	72,300
Polymerization	8,200 (Product)
Alkylation	2,500 (Product)
Isomerization C-5/C-6	0

*Includes 28,300 BPCD Hydrocracking

TABLE 2-11

ONTARIO REGION

INSTALLED REFINERY PROCESS UNIT CAPACITIES

UNIT TYPE		BPCD
Crude Distillation		530,000
Vacuum Distillation		178,000
Catalytic Reforming, Installed		122,000
	98 RON rated	111,400
	100 RON rated	87,500
Catalytic Cracking		152,000*
Distillate Desulphurization		72,300
Polymerization		0
Alkylation		20,800 (Product)
Isomerization C-5/C-6		0

* Includes 37,100 BPCD Hydrocracking

TABLE 2-12

WESTERN REGION

INSTALLED REFINERY PROCESS UNIT CAPACITIES

UNIT TYPE		BPCD	
Crude Distillation		615,000	
Vacuum Distillation		177,000	
Catalytic Reforming,	Installed	106,400	
	98 RON rated	94,300	
	100 RON rated	75,900	
Catalytic Cracking		189,000*	
Distillate Desulphurization		178,000	
Polymerization		6,300	(Product)
Alkylation		25,200	(Product)
Isomerization C-5/C-6		0	

* Includes 32,700 BPCD of Hydrocracking

TABLE 2-13

REFINERY OPERATING CONSTRAINTS

LSR	End Point	170Deg.FVT
Naphtha	End Point	400Deg.FVT
Kerosene	End Point	560Deg.FVT
LGO	End Point	660Deg.FVT
HVGO	End Point	1050Deg.FVT
Naphtha in Jet B	ASTM 90%	470Deg.F (max.)
Naphtha in Jet A	Pour Point	- 50Deg.F (max.)
LSR in Jet B	RVP	2-3 (max.)
LCO	End Point	650Deg.FVT (max.)
Cat Cracker Conversion		50-80 Wt.%
Reformer Severity		
--Existing Equipment		100 RON
--New Equipment		103 RON

TABLE 2-14

GENERAL PRODUCT SPECIFICATIONS 1990

		Market	Gov't.
Leaded Regular Gasoline			
Octane No.	(RON+MON/2	89.8	87.0
Lead Content	gms Pb/l	0.29	
RVP	PSIA	7.0 - 12.5	
Unleaded Regular Gasoline			
Octane No.	(RON+MON)/2	89.0	87.0
RVP	PSIA	7.0-12.5	
MMT Content	mg of Mn/l	18	
Unleaded Premium Gasoline			
Octane No.	(RON+MON)/2	91.8	90.0
RVP	PSIA	7.0 - 12.5	
MMT Content	mg of Mn/l	18	
Aviation Gasoline			
Octane No.	RON	93.0	
RVP	PSIA	10.0	
Turbo Fuel Jet B (Naphtha Base)			
Specific Gravity		0.750 - 0.801	
ASTM Distillation %	20/50/90, Deg.F	290/370/470 (max.)	
RVP	PSIA	2 - 3	
Sulphur	Wt.%	0.4 (max.)	
Turbo Fuel Jet A (Kerosene Base)			
Specific Gravity		0.774 - 0.839	
Pour Point Deg. F		- 50 (max.)	
ASTM Distillation 10%	Deg.F	400 (max.)	
Flash Point	Deg. F	90 (min.)	
Sulphur	Wt.%	0.2 (max.)	

GENERAL PRODUCT SPECIFICATIONS 1990 (cont'd)

Diesel Fuel

Pour Point	Deg. F	-10	(max.)
Specific Gravity		.816 - 0.855	
ASTM Distillation %	10/50/90 Deg.F	.460/520/625	(max.)
Flash Point	Deg. F	105	(min.)
Cetane Index		45	(min.)
Viscosity @ 100Deg.F	CS	1.85 - 3.95	
Sulphur	Wt.%	0.4	(max.)

Stove Oil

Pour Point	Deg. F	-40	(max.)
Specific Gravity		0.784 - 0.840	
ASTM Distillation %	10/50/90 Deg.F	420/450/520	(max.)
Flash Point	Deg. F	120	(min.)
Viscosity @ 100Deg.F	CS	1.25	(min.)
Sulphur	Wt.%	0.2	(max.)

Light Fuel Oil (#2)

Pour Point	Deg. F	0	(max.)
Specific Gravity		0.820 - 0.887	
ASTM Distillation %	10/50/90 Deg.F	460/530/675	(max.)
Flash Point	Deg. F	105	(min.)
Viscosity @ 100Deg. F	CS	1.75 - 4.25	
Sulphur	Wt.%	0.5	(max.)

Heavy Fuel Oil

Sulphur	Wt.%	3.5	(max.)
Viscosity @ 122Deg.F	CS	92 - 638	

TABLE 2-15

SUMMARY OF CRUDE ANALYSES

Source/Type	Gravity Deg.API	WT% S	Specific Assays Used
Domestic			
Light	38.9	.44	IPL Blend #1/#2
Heavy	25.1	2.39	Bow Bell
Synthetic	27.7	.08	Syncrude Synthetic
Condensate	69.7	.06	Rimbey
Frontier	30.4	1.26	(Note 1)
Imported			
Venezuelan Light	30.4	1.26	Ceuta
Venezuelan Heavy	16.8	2.40	Bachaquero
Arabian Light	34.4	1.70	Arabian Light
Arabian Heavy	28.2	2.84	Arabian Heavy
Mexican Light	32.9	1.5	Isthmus
Mexican Heavy	22.0	3.3	Maya
North Sea	35.1	0.41	North Sea

Note 1:

Assumed to be of the same quality as Venezuelan Light.

TABLE 2-16

GASOLINE COMPONENT PROPERTIES

	RVP	RON	Sensitivity (RON-MON)	
Reformate	5.0	a	0.1(RON)+1	0
Alkylate	8.5	93.0	2.2	0
Polymer	4.5	96.5	14.0	0
Crackate	4.5	b	0.075(RON)+4.25	f
Light Straight Run(LSR)	c	c	c	c
Isomerate	e	d	e	e
C-4	55.0	93.0	2-0	0

Notes:
a. Specified for each case
b. Varies between 91.5 and 94.4 depending on conversion.
c. Estimated from crude assay data
d. RON of LSR +13.0 for once-thru. 90 RON and 87 MON for total isomerization.
e. Same as for LSR
f. Estimated from cat feed sulphur content.

TABLE 2-17

REGIONAL FEEDSTOCK, PRODUCT AND UTILITY PRICES FOR 1984

Item	Unit	Atlantic	Quebec	Ontario	Western	Source of Information
Electricity	cents/KW	4.53	2.58	2.8	2.15	Ont.-Hydro and MECo *
Crude Oil	$/bbl	35.43	35.97	36.28	35.53	EMR
HFO	$/bbl	26.11	26.87	27.57	25.23	EMR
i-C4	$/bbl	---	---	30.21	28.62	EMR
Lead Additives	cents /cc.TEL	0.47	0.47	0.47	0.47	Ethyl Can.
MMT Additives	cents /g Mg	6.37	6.37	6.37	6.37	Ethyl Can.

* Escalated.

TABLE 2-18

PROCESS UNIT ENERGY REQUIREMENT

Total Isomerization	Unit Energy Requirement 10^3 BTU/bbl Feed
Crude	95
Vacuum	60
Cracker	100
Poly	500
Alkyl	500
Reformer	290 @ 90 RON 365 @ 100 RON
Naphtha Hydrotreater	90
Isomerization	100
Total Isomerization	200
Gas Plant	600
Aromatics Extraction	130

TABLE 2-19

SUMMARY OF MOTOR GASOLINE
OCTANE QUALITY FOR SIMULATIONS

REGION	CASE	Leaded Regular	Unleaded Regular	Unleaded Premium
		-------OCTANE NUMBER (R+M)/2------		
Atlantic	Market	89.8	89.0	91.8
	CGSB	87	87	90
Quebec	Market	89.8	89.0	91.8
	CGSB	87	87	90
Ontario	Market	89.8	89.0	91.8
	CGSB	87	87	90
Western *	Market	88.3	88.3	90.8
	CGSB	85	85	88

* Actual simulation values used were the same as other regions to compensate for octane barrels equivalent of aromatics removed from gasoline for petrochemicals. (See Section 2.3)

TABLE 2-20

OPERATING REFINERIES

Atlantic

Irving	Saint John
Imperial	Dartmouth
Texaco	Halifax

Quebec

Gulf	Montreal East
Petro-Canada	Pointe-aux-Trembles
Shell	Montreal East
Ultramar	St-Romuald

Ontario

Imperial	Sarnia	
Petro-Canada	Oakville	
Shell	Corunna	
Suncor	Sarnia	
Texaco	Nanticoke	
Petrosar	Corunna	(petrochemical refinery)
Gulf	Clarkson	(limited use)

Western

Chevron	Burnaby	
Gulf	Port Moody	
Husky	Prince George	
Imperial	Ioco	
Petro-Canada	Taylor	
Shell	Burnaby	
Imperial	Norman Wells	
Co-Op	Regina	
Gulf	Edmonton	
Imperial	Edmonton	
Shell	Bowden	
Shell	Scotford	
Turbo	Balzac	
Gulf	Moose Jaw	(asphalt refinery)
Husky	Lloydminster	(asphalt refinery)

Reference: Hycarb Engineering (14)

3.0 DISCUSSION OF CASE SIMULATIONS

INTRODUCTION

The previous section examined the basis and technique used to arrive at a simulation of the capabilities and potential of the Canadian refining Market. This section contains a discussion of the results of the various cases which were developed and details the optimizing processes used to arrive at an acceptable 1990 product slate. For each region, the optimizing process was carried out to determine the type and extent of modifications necessary to meet the demand, in order to provide a basis for the costs developed in the following section. The results are presented in tabular form with a commentary on adjustment to feedstocks, additional processes used and their relation to the existing capability of regional plants.

3.1 Base Case

To provide a basis for determining the petroleum refining Market's capital investment, operating costs and energy efficiency of removing MMT from motor gasolines, two base cases using MMT in unleaded gasolines were run for each region; one case using "Market" targets and the other using the "CGSB" targets.

The same octanes were used in all regions. The normal downrating in Western Canada was not applied in order to compensate for extracted aromatics, which were estimated to be equivalent to two octane numbers.

TEL addition to Leaded Regular Grade was taken as 0.29 grams of lead equivalent/litre and MMT addition to the unleaded grades 18 milligrams/litre manganese equivalent.

Atlantic Region

Initial runs for the Atlantic region, using available crude types, would not meet viscosity levels on the Heavy Fuel Oil. This indicates a need for some form of bottoms reduction, a simulation not available in the model. In order to simulate the effect of residual reduction, an amount of syncrude quality material was added to the crude blend to produce an acceptable HFO.

Crude types also indicated more paraffins than those from Western Canadian sources, requiring that the end point and initial Boiling Point of the stove oil be lowered in order to meet the pour point.

Market octanes could not be met with the reformer at 100 RON. Therefore, once through isomerization was added, reducing reformer severity to 98 RON. There is no alkylation capacity in the Atlantic region, which results in higher research octane (RON) requirements in order to meet the specifications. CGSB octanes were quite readily met with reforming severity at 94 RON.

Crude runs and feed rates to secondary units in both cases were well within rated capacities shown in Table 2-9.

Quebec Region

The residual situation in the Quebec area was the reverse of that in the Atlantic. A proportionally higher HFO requirement, coupled with syncrude in the crude blend, resulted in an HFO viscosity below specification. All imported crudes were adjusted to heavy types and domestic heavy was increased at the expense of domestic light and syncrude until satisfactory HFO quality was produced.

The pour points of straight run stocks improved and the end point on the Heavy Straight Run naphtha was increased to maximize reformer feed.

Once through isomerization was required to meet Market octane levels. Balance was reached with isomerization of 80% of the C5-170DEG,F. LSR material and reformer severity at 96 RON. CGSB octanes were met with existing equipment and a reformer severity of 90 RON.

Feed rates to both primary and secondary units were well within the rated capacities shown in Table 2-10.

Ontario Region

Additional syncrude was added to the crude blend to simulate residual upgrading and produce an HFO with an acceptable viscosity. Additional condensate was also added to the feed to compensate for the amount deducted from petrochemical feed.

The pour point of straight run stocks improved and the end point on the kerosene cut was raised to 560 DEG.F as limited by the 90% point on the Stove Oil specification.

Market octanes could not be met with 100 RON reformer severity. While sizeable amounts of C3/C4 olefins are produced surplus to the capacity of existing alkylation unit , this surplus was taken to be equivalent to refinery olefins diverted to petrochemical feed. Therefore alkylate production was limited essentially to installed capacity. Gasoline octanes were balanced with isomerization of 45% of the C5-170 DEG.F LSR and a reformer severity of 96.5.

CGSB octanes were met with existing processing and a reformer severity of 93.3.

With the exception of alkylation, as previously explained, crude runs and secondary unit feed rates were well within the rated capacity shown in Table 2-11.

Western Region

Once more additional syncrude was added to the crude blend to simulate residual reducing processing and produce an HFO of acceptable viscosity.

Both Market and CGSB octane requirements were met with existing equipment at reformer severities of 96.5 RON and 90 RON respectively, the octane requirement being adjusted upward to compensate for the aromatics extracted from the reformate for petrochemicals.

As in the other regions the various feed rates to the process units were well within the rated capacities for the region, as shown in Table 2-12.

3.2 MMT Free Cases

To determine the relative increase in processing severity, or additional processing required, if MMT were not used in the unleaded gasoline, alternate cases for each base case were run. These used the same crude blend, product specifications including octane levels, and the same product slate with one exception. The volume of Leaded Regular gasoline was reduced from 30% to 10% of the pool. The volume of Unleaded Premium grade was left the same and the Unleaded Regular increased to maintain the same total volume.

The allowable level of TEL addition to the Leaded Regular grade was the same as that used in the base cases.

Atlantic Region

Market octane levels could not be met with once through isomerization and 100 RON reformer severity. When total normals recycle was added, octane balance was reached with total isomerization of 85% of the LSR and 98 RON reformer severity. All of the octane barrels required to replace the MMT were produced by the isomerate. This is reflected in the crude rate, which is essentially the same as that in the base case and well within rated capacities.

CGSB octanes could also no longer be met with existing equipment. Once through isomerization was added and at isomerization of 100% of the LSR and 96 RON reformer severity, octane requirements were met.

Quebec Region

Once through isomerization and 100 RON reformate were unable to meet Market octane requirements. The pool octane balance was reached with total isomerization of 100% of the C5-170 DEG.F LSR and a reformer severity of 97 RON. Crude run was increased marginally to make up for the increased severity at the reformer but the feed rates to all units were still well within rated capacities.

Installed equipment did not meet the CGSB octane levels either and once through isomerization was required. Octane blending was balanced by isomerizing 70% of the LSR and 96 RON Reformer severity.

Ontario Region

In the base case, Market gasoline octane requirements were met with once through isomerization of only 45% of the LSR and a Reformer severity of 96.5 RON. The shortfall of octane barrels can be made up by once through isomerization of 100% of the LSR and increasing reformer severity to 98.0 RON. The additional crude run was relatively small (<1%) and rated process unit capacities were quite adequate.

Once through isomerization had to be added to achieve the CGSB octane levels. The gasoline pool was balanced with once through isomerization of 80% of the LSR and a reformer severity of 96 RON.

Western Region

Once through isomerization had to be added to meet Market octanes. Gasoline pool octane requirements were met with once through isomerization of 90% of the LSR and a Reformer severity of 96.5 RON. The additional crude required was marginal and other process unit capacities were well within rated values.

The CGSB octane requirements were met solely by raising reformer severity from 90 to 92.8 RON and no new equipment was required.

3.3 Energy Penalties

Tables 3-1 to 3-5 summarize the effects on crude throughput and energy penalty for the four regions that result from the increased process severity required to replace the octane barrels provided by MMT in the base cases.

The results to a large extent reflect the difference in losses between catalytic reforming and isomerization to obtain octane barrels. In going from 90 to 100 RON severity, the yield of C5 + reformate reduces from 85 to 76% of feed. The recovery of isomerate on the other hand, ranges from 98.4% for once through operation to 98% for total recycle.

The eight comparisons shown in the tables reflect various combinations of isomerization and reforming severity.

In the Atlantic region, the Market octanes in the MMT free cases were met solely by going to total recycle isomerization and holding reformer severity constant. This results in only a nominal change in crude run. The energy penalty is small and largely attributable to the new isomerization units.

The CGSB case in the Western region illustrates the effect of increased reformer severity alone while that of the CGSB case in Ontario region shows the combined effect of increased reformer severity and the addition of once through isomerization.

In general, the elimination of MMT from the unleaded grades of gasoline results in higher crude runs and higher energy penalties. The magnitude of these increases depends upon the severity of processing used. The combination of processing which results in the greatest yield loss to produce a given amount of octane barrels shows the greatest increase in crude run coupled with greatest energy penalty.

TABLE 3-1

SUMMARY OF RESULTS

ATLANTIC REGION

Case	Reformer Severity	C-5/C-6 Isomerization	Crude Oil Rate BPCD	Crude Rate Increase %	iC-4 Imported	Fuel Gas BPCD (FOE)	Energy Penalty %
Market:							
BASE	98	ONCE THRU (100%)	136,386	---	0	6,207	---
CASE (No MMT)	98	TOTAL (85%)	136,370	-0.012	0	6,184	0.042
CGSB:							
BASE	94	NONE	135,547	---	0	5,300	---
CASE (NO MMT)	96	ONCE THRU (100%)	135,946	0.294	0	5,751	0.225

TABLE 3-2

SUMMARY OF RESULTS

QUEBEC REGION

Case	Reformer Severity	C-5/C-6 Isomerization	Crude Oil Rate BPCD	Crude Rate Increase %	iC-4 Imported	Fuel Gas BPCD (FOE)	Energy Penalty %
Market:							
BASE	96	ONCE THRU (80%)	276,710	---	0	17,792	---
CASE (No MMT)	97	TOTAL (100%	277,389	0.245	0	18,470	0.212
CGSB:							
BASE	90	NONE	274,571	---	0	15,378	---
CASE (NO MMT)	92	ONCE THRU (70%)	276,121	0.565	0	16,794	0.255

TABLE 3-3

SUMMARY OF RESULTS

ONTARIO REGION

Case	Reformer Severity	C-5/C-6 Isomerization	Crude Oil Rate BPCD	Crude Rate Increase %	iC-4 Imported	Fuel Gas BPCD (FOE)	Energy Penalty %
Market:							
BASE	96.5	ONCE THRU (45%)	447,197	---	3050	28,046	---
CASE (NO MMT)	98	ONCE THRU (100%)	449,052	0.415	2656	30,018	0.263
CGSB:							
BASE	93.3	NONE	444,470	---	3471	24,945	---
CASE (NO MMT)	95	ONCE THRU (70%)	446,231	0.396	3064	27,019	0.318

TABLE 3-4

SUMMARY OF RESULTS

WESTERN REGION

Case	Reformer Severity	C-5/C-6 Isomerization	Crude Oil Rate BPCD	Crude Rate Increase %	iC-4 Imported	Fuel Gas BPCD (FOE)	Energy Penalty %
Market:							
BASE	96.5	NONE	494,602	---	1613	25,185	---
CASE (No MMT)	98	ONCE THRU (90%)	495,008	0.082	1448	25,741	0.210
CGSB:							
BASE	90	NONE	491,056	---	1853	19,499	---
CASE (NO MMT)	92.8	NONE	492,068	0.206	1722	21,369	0.114

SIMULATION RESULTS

TABLE 3-5

BASE :-18 mg/l MMT 70/30 Split

REGION:-ATLANTIC- CGSB

CASE1:-0 MMT 90/10 Split

PROCESS UNIT	CASE-1 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	135946	135547	399	95	37.905
VACUUM DISTILLATION	61844	61662	182	60	10.92
CATALYTIC CRACKER	43730	43600	130	100	13
CATALYTIC POLYMERIZATION	3554	3501	53	500	26.5
HF ALKYLATION	0	0	0	500	0
CATALYTIC REFORMER (SEVERITY)	9650 96	9600 94	50	335 (CASE) 320 (BASE)	160.75
HYDROTREATER NAPTHA	9650	9600	50	90	4.5
ISOMERISATION	6279 (ONCE THRU')	0 (ONCE THRU')	6279	100 (CASE) 100 (BASE)	627.9
HDS-LSR	6279	0	6279	90	565.11
GAS PLANT	14586	14044	542	600	325.2
FUEL GAS (FOE)	5751	5300	451	TOTAL	1771.79
HFO PRODUCTION	13901	13901	0		
IMPORTED I-C4	0	0	0		

TABLE 3-6

SIMULATION RESULTS

BASE :-18 mg/l MMT 70/30 Split

CASE1:-0 MMT 90/10 Split

REGION:-QUEBEC - CGSB

PROCESS UNIT	CASE-1 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	276121	274571	1550	95	147.25
VACUUM DISTILLATION	133790	133039	751	60	45.06
CATALYTIC CRACKER	88525	88965	-440	100	-44
CATALYTIC POLYMERIZATION	7434	7037	397	500	198.5
HF ALKYLATION	1900	2431	-531	500	-265.5
CATALYTIC REFORMER (SEVERITY)	33000 92	32600 90	400	305 (CASE) 290 (BASE)	611
HYDROTREATER NAPTHA	33000	32600	400	90	36
ISOMERISATION	12790 (ONCE THRU')	0 (ONCE THRU')	12790	100 (CASE) 100 (BASE)	1279
HDS-LSR	12790	0	12790	90	1151.1
GAS PLANT	36246	34632	1614	600	968.4
FUEL GAS (FOE)	16794	15378	1416	TOTAL	4126.8
HFO PRODUCTION	55901	55901	0		
IMPORTED I-C4	0	0	0		

SIMULATION RESULTS

TABLE 3-7

BASE :-18 mg/1 MMT 70/30 Split

CASE1:-0 MMT 90/10 Split

REGION:-ONTARIO - CGSB

PROCESS UNIT	CASE-1 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	446231	444470	1761	95	167.295
VACUUM DISTILLATION	154141	153533	608	60	36.48
CATALYTIC CRACKER	126425	125790	635	100	63.5
CATALYTIC POLYMERIZATION	0	0	0	500	0
HF ALKYLATION	20736	20736	0	500	0
CATALYTIC REFORMER (SEVERITY)	61750 95	61250 93.3	500	327.5 (CASE) 314.75 (BASE)	944.688
HYDROTREATER NAPTHA	61750	61250	500	90	45
ISOMERISATION	28392 (ONCE THRU')	0 (ONCE THRU')	28392	100 (CASE) 100 (BASE)	2839.2
HDS-LSR	28392	0	28392	90	2555.28
GAS PLANT	52654	50311	2343	600	1405.8
FUEL GAS (FOE)	27019	24945	2074	TOTAL	8057.24
HFO PRODUCTION	33274	33274	0		
IMPORTED I-C4	3064	3471	-407		

SIMULATION RESULTS

TABLE 3-8

BASE :-18 mg/l MMT 70/30 Split

REGION:-WESTERN - CGSB

CASE1:-0 MMT 90/10 Split

PROCESS UNIT	CASE-1 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	492068	491056	1012	95	96.14
VACUUM DISTILLATION	173674	173317	357	60	21.42
CATALYTIC CRACKER	141235	140639	596	100	59.6
CATALYTIC POLYMERIZATION	6115	6115	0	500	0
HF ALKYLATION	20581	20422	159	500	79.5
CATALYTIC REFORMER (SEVERITY)	71500 92.8	71000 90	500	311 (CASE) 290 (BASE)	1646.5
HYDROTREATER NAPTHA	71500	71000	500	90	45
ISOMERISATION	0 (ONCE THRU')	0 (ONCE THRU')	0	100 (CASE) 100 (BASE)	0
HDS-LSR	0	0	0	90	0
GAS PLANT	60934	58845	2089	600	1253.4
FUEL GAS (FOE)	21369	19499	1870	TOTAL	3201.56
HFO PRODUCTION	24342	24342	0		
IMPORTED I-C4	1722	1853	-131		

SIMULATION RESULTS

TABLE 3-9

BASE :-18 mg/1 MMT 70/30 Split

REGION:-ATLANTIC - MARKET

CASE1:-0 MMT 90/10 Split

PROCESS UNIT	CASE-1 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^{-3} BTU/BBL)	ADDN ENERGY REQUIREMENT (10^{-6} BTU/CD)
CRUDE DISTILLATION	136370	136386	-16	95	-1.52
VACUUM DISTILLATION	62037	62044	-7	60	-.42
CATALYTIC CRACKER	43865	43870	-5	100	-.5
CATALYTIC POLYMERIZATION	3735	3735	0	500	0
HF ALKYLATION	0	0	0	500	0
CATALYTIC REFORMER (SEVERITY)	8900 98	8900 98	0	350 (CASE) 350 (BASE)	0
HYDROTREATER NAPTHA	8900	8900	0	90	0
ISOMERISATION	5357 (TOTAL)	6314 (ONCE THRU')	-957	200 (CASE) 100 (BASE)	440
HDS-LSR	5357	6314	-957	90	-86.13
GAS PLANT	15305	15329	-24	600	-14.4
FUEL GAS (FOE)	6184	6207	-23	TOTAL	337.03
HFO PRODUCTION	13901	13901	0		
IMPORTED I-C4	0	0	0		

SIMULATION RESULTS

TABLE 3-10

BASE :-18 mg/l MMT 70/30 Split

CASE1:-0 MMT 90/10 Split

REGION:-QUEBEC - MARKET

PROCESS UNIT	CASE-1 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	277389	276710	679	95	64.505
VACUUM DISTILLATION	134404	134075	329	60	19.74
CATALYTIC CRACKER	90960	90720	240	100	24
CATALYTIC POLYMERIZATION	7484	7404	80	500	40
HF ALKYLATION	2149	2155	-6	500	-3
CATALYTIC REFORMER (SEVERITY)	32900 97	32800 96	100	342.5 (CASE) 335 (BASE)	280.25
HYDROTREATER NAPTHA	32900	32800	100	90	9
ISOMERISATION	18443 (TOTAL)	14740 (ONCE THRU')	3703	200 (CASE) 100 (BASE)	2214.6
HDS-LSR	18443	14740	3703	90	333.27
GAS PLANT	38171	37368	803	600	481.8
FUEL GAS (FOE)	18470	17792	678	TOTAL	3464.17
HFO PRODUCTION	55901	55901	0		
IMPORTED I-C4	0	0	0		

SIMULATION RESULTS

TABLE 3-11

BASE :-18 mg/l MMT 70/30 Split

CASE1:-0 MMT 90/10 Split

REGION:-ONTARIO - MARKET

PROCESS UNIT	CASE-1 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	449052	447197	1855	95	176.225
VACUUM DISTILLATION	155116	154475	641	60	38.46
CATALYTIC CRACKER	128775	126770	2005	100	200.5
CATALYTIC POLYMERIZATION	0	0	0	500	0
HF ALKYLATION	20811	20807	4	500	2
CATALYTIC REFORMER (SEVERITY)	62500 98	62500 96.5	0	350 (CASE) 338.75 (BASE)	703.125
HYDROTREATER NAPTHA	62500	62500	0	90	0
ISOMERISATION	40667 (ONCE THRU')	18212 (ONCE THRU')	22455	100 (CASE) 100 (BASE)	2245.5
HDS-LSR	40667	18212	22455	90	2020.95
GAS PLANT	55968	53752	2216	600	1329.6
FUEL GAS (FOE)	30018	28046	1972	TOTAL	6716.36
HFO PRODUCTION	33274	33274	0		
IMPORTED I-C4	2656	3050	-394		

SIMULATION RESULTS

TABLE 3-12

BASE :-18 mg/l MMT 70/30 Split

REGION:-WESTERN - MARKET

CASE1:-0 MMT 90/10 Split

PROCESS UNIT	CASE-1 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	495008	494602	406	95	38.57
VACUUM DISTILLATION	174712	174568	144	60	8.64
CATALYTIC CRACKER	143600	143173	427	100	42.7
CATALYTIC POLYMERIZATION	6116	6116	0	500	0
HF ALKYLATION	21218	21102	116	500	58
CATALYTIC REFORMER (SEVERITY)	72200 96.5	72200 96.5	0	338.75 (CASE) 338.75 (BASE)	0
HYDROTREATER NAPTHA	72200	72200	0	90	0
ISOMERISATION	27959 (ONCE THRU')	0 (ONCE THRU')	27959	100 (CASE) 100 (BASE)	2795.9
HDS-LSR	27959	0	27959	90	2516.31
GAS PLANT	66031	65248	783	600	469.8
FUEL GAS (FOE)	25741	25185	556	TOTAL	5929.92
HFO PRODUCTION	24342	24342	0		
IMPORTED I-C4	1448	1613	-165		

TABLE 3 - 13

TYPICAL CALCULATION OF ENERGY PENALTY

ATLANTIC REGION - Market

Base Crude Consumed = 136 386 BPCD.

= 4.77×10^{6} IG/CD

Crude Gravity = 31.64° API = .8674 SG

HHV of Crude Oil = [18320 + 40(31.64-10)]X10X.8674

= 166 407 BTU/IG

Energy Content of Base Crude Consumed = $4.77 \times 10^{6} \times 166{,}407$

= $793\ 761 \times 10^{6}$ BTU/CD

Additional Energy Required = 337.03×10^{6} BTU/CD

Energy Penalty =

$$\frac{337.03 \times 10^{6} \times 100}{793\ 761 \times 10^{6}} \text{ TYPICAL}$$

= 0.042%

4.0 COSTS

INTRODUCTION

This section describes the methodology and rationale used to develop the operating and capital cost estimates pertaining to the cases developed in the previous sections of this report.

The validity date of all costs in this Section is the first quarter of 1984. The capital costs developed can be classified as order of magnitude estimates which are normally considered to have a plus or minus 30% accuracy and are reported in 1984 Canadian dollars.

The initial part of this Section essentially defines the terms and limitations on which the costing exercise was based.

4.1 CAPITAL COSTS

4.1.1 SIZING OF NEW UNITS

For the purposes of capital cost estimation, the single regional refinery approach would result in large units which, in practice, would understate the actual capital costs involved.

For cost estimation purposes, the new regional processing units were sized to suit the individual refineries in direct proportion to each refinery's installed crude capacity. In cases where required isomerization capacity was significantly less than 100%, it was assumed that not all refineries in that region would add new isomerization units. In these cases, new processing was allocated to selected refineries to supply the capacity required. Capacity was then distributed among the selected refineries in direct proportion to each refinery's installed crude capacity.

The capital cost for once through and total isomerization units was built up from the following components.

	Once Through Isomerization	Total Isomerization
(1)	Feed Fractionation	Feed Fractionation
(2)	Feed Hydrotreating	Feed Hydrotreating
(3)	*Isom. Unit (Reactor Section)	Isom. Unit (Reactor Section)
(4)		Normals extraction (Molecular Sieve Section)

* Includes feed driers, make-up gas driers, tail gas neutralization, and flare facilities.

Feed fractionation consists of a naptha splitter sized to handle full cut naptha from crude distillation.

Feed hydrotreating was sized at 100% of actual required isomerization capacity. This capacity was uprated to reflect conversion from BPCD to BPSD by application of a service factor of 95%.

The reactor section of the isomerization unit was sized at 120% of available isomerization feed to allow for recycle to extinction of the normals recovered in the sieve section. In cases where once through isomerization only was required, this additional capacity represents pre-investment for the later addition of a sieve section.

The sieve sections of the isomerization units were also sized at 120% of available isomerization feed, to handle recycle.

Reactor section and molecular sieve section capacities were uprated to reflect conversion from BPCD to BPSD by application of service factor of 95%.

Table 4-1 shows the regional requirement of new processing units.

Tables 4-2 to 4-5 show the allocation of individual units within the regions.

Increased inventory costs have been interpreted as extra crude oil storage, necessarily induced by the incremental crude oil throughput. Based on an assumed strategic requirement of 30 days storage, this translates to a "one of" extra crude oil cost.

The possibilities of upgrading existing units, to higher capacities have not been addressed in this report. It is also feasible that individual refineries may elect to upgrade their facilities using other types of process units or may utilize existing equipment. Savings exceeding 50% on capital costs could be achieved on isomerization units by converting existing redundant reformers. However, such discussion as to the capital cost expenditures and planning of individual refineries is beyond the scope of this study.

4.1.2 Basis of Estimate

Capital cost data was derived during the course of the study primarily from major licensors (UOP & BP) of the proprietary technology, to ensure that latest data was applied. This information was supplemented as required with refinery planning and experience data obtained from an in-house cost library.

Pertinent cost estimating data was compiled and a representative average cost curve developed for varying processing capacities of the five basic types of units covered. Representative capacity versus cost data is shown on Table 4-6.

The scope of the estimate includes all direct material and labour, indirect field costs and labour benefits which are associated with the erection of battery limits process equipment including the following specific equipment categories and services:

(a) Battery Limits Process Equipment

Heaters
Vessel and internals
Heat exchange equipment
Pumps
Drivers
Compressors

(b) Battery Limits Process Materials

Piping
Instruments
Electrical
Insulation
Structural steelwork
Fireproofing

(c) Battery Limits Industrial Buildings

Compressor shelter
Control house

(d) Battery Limits Civil

Paving and concrete work

(e) Battery Limits Auxiliary Facilities

Catalyst handling equipment
Catalyst initial fill

(f) Battery Limits Construction Services

Sundry construction equipment
Temporary field office, warehouse, changehouse
Field testing
Expendable tools
Clerical costs associated with construction
Final cleaning
Miscellaneous field costs
Fringe benefits

(g) Battery Limits Engineering Costs

An allowance for design engineering and contractor's fees, overheads and expenses has been added to the total material and labour estimate in order to reach an overall erected cost estimate for the battery limits plant. This allowance is intended to cover the following charges.

Basic process and engineering design
 specifications and drawings (Schedule A package)
Detailed engineering
Construction tools and equipment rental
Contractor's field and home office expenses
Erection supervision
Contractor's fees

(h) Other Costs

In addition an allowance of 30% of the battery limit capital cost was made for additions or extensions to utility systems and offsites.

EXCLUSIONS

Items not included in the estimated capital costs are as follows:

Cost of land, site preparation and soil investigation
Piling or any unusual foundation requirement
Docks, marine terminals or jetties
Access roads to site
Home office administrative building
Employee housing, barracks, canteens, etc.
Overtime pay during construction
Royalties on licensed processes
Owner's expenses in developing project
Local, provincial, federal taxes or fees
Items concerned with export shipment
Operating capital and investment in goods
Escalation on material and labour
Contingencies
Cost of start-up including testing, manpower, utilities, operations manuals and training programs
Spare parts, special tools or maintenance equipment
Chemicals and raw materials
Customer codes
Special pollution or noise control facilities
Special communication or computer systems

ESTIMATE STRUCTURE

The total capital investment cost is given per refinery location. The estimate structure of each refinery location comprises:

A. ON SITE CAPITAL COSTS

Isomerization

1.1 Fractionation
1.2 Hydrotreater
    -- Catalyst
1.3 Once-Through Isomerization
    -- Catalyst
1.4 Total Isomerization
    -- Catalyst

Total Isomerization Cost

TOTAL ON SITE CAPITAL COST

B. TOTAL OFFSITE CAPITAL COST (30%)

TOTAL INVESTMENT COST

Pricing Basis

The cost versus capacity relationship derived is represented by:

$$\text{Capital Cost} = \left[\frac{\text{capacity in study case}}{\text{capacity in reference}}\right]^{Y} \times (\text{Reference Cost})$$

where the exponent "y" is the scale factor.

It was necessary to make some adjustment to the methodology as it applies to low capacity process units. For each process unit a range of capacities was established, based on the characteristic cost versus capacity relationship. All plants that fell below the lower boundary of this range were costed at this point.

Capital Cost Summaries

The summary tables (Tables 4-8 to 4-9) report the estimated capital investment cost by region and overall. Additionally, a complete breakdown of costs pertaining to individual refineries is provided (Tables 4-10 to 4-32). Refinery locations are purposely coded as it is outside the scope of this study to make recommendations pertaining to individual refineries.

Credits (Cost Data)

UOP Process Division, Des Plaines, Illinois
BP International Ltd., England

TABLE 4-1

SUMMARY OF REQUIRED NEW UNIT CAPACITY

	ISOMERIZATION UNIT					
CASE	BPCD FRESH FEED	BPSD (FOR COST ESIMATION)				TYPE OF ISOM UNIT
		FRACTIONATION	HYDROTREATING	REACTOR SEC'T	SIEVE SEC'T	
CGSB OCTANES						
ATLANTIC-BASE	-	-	-	-	-	-
ATLANTIC-CASE1	6313	19,999	6645	7976	-	ONCE THRU
QUEBEC-BASE	-	-	-	-	-	-
QUEBEC-CASE1	12947	42,010	13628	16354	-	ONCE THRU
ONTARIO-BASE	-	-	-	-	-	-
ONTARIO-CASE1	32209	102,966	33904	40685	-	ONCE THRU
WESTERN-BASE	-	-	-	-	-	-
WESTERN-CASE1	-	-	-	-	-	-
MARKET OCTANES						
ATLANTIC-BASE	6313	18,991	6645	7976	-	ONCE THRU
ATLANTIC-CASE1	6313	18,977	6645	7976	7976	TOTAL ISOM
QUEBEC-BASE	14739	48,632	15515	18618	-	ONCE THRU
QUEBEC-CASE1	18445	58,020	19416	23299	23299	TOTAL ISOM
ONTARIO-BASE	18213	57,503	19171	23006	-	ONCE THRU
ONTARIO-CASE1	40666	130,303	42806	51367	-	ONCE THRU
WESTERN-BASE	-	-	-	-	-	-
WESTERN-CASE1	27957	126,867	29428	35315	-	ONCE THRU

TABLE 4-2

DETAILED SUMMARY OF REQUIRED NEW UNIT CAPACITIES

CGSB OCTANES - BASE

ISOMERIZATION UNIT

Refinery #	Req'd Iso. Capacity	Full Cut Naptha	Isom. Feed	Hydrotreater	Reactor Section	Sieve Section	Isom. Type
	FRESH FEED BPCD	-FRACTIONATION- BPSD	BPSD	BPSD	BPSD	BPSD	
Atlantic	----	----	----	----	----	--	----
1	----	----	----	----	----	--	----
2	----	----	----	----	----	--	----
3	----	----	----	----	----	--	----
Total (Atlantic)	----	----	----	----	----	--	----
Quebec							
1	----	----	----	----	----	--	----
2	----	----	----	----	----	--	----
3	----	----	----	----	----	--	----
4	----	----	----	----	----	--	----
Total (Quebec)	----	----	----	----	----	--	----
Ontario							
1	----	----	----	----	----	--	----
2	----	----	----	----	----	--	----
3	----	----	----	----	----	--	----
4	----	----	----	----	----	--	----
5	----	----	----	----	----	--	----
Total (Ontario)							
Western							
1	----	----	----	----	----	--	----
2	----	----	----	----	----	--	----
3	----	----	----	----	----	--	----
4	----	----	----	----	----	--	----
5	----	----	----	----	----	--	----
6	----	----	----	----	----	--	----
7	----	----	----	----	----	--	----
8	----	----	----	----	----	--	----
9	----	----	----	----	----	--	----
10	----	----	----	----	----	--	----
11	----	----	----	----	----	--	----
Total (Western)	----	----	----	----	----	--	----

TABLE 4-3

DETAILED SUMMARY OF REQUIRED NEW UNIT CAPACITIES

CGSB OCTANES - CASE1

ISOMERIZATION UNIT

Refinery #	Req'd Iso. Capacity	Full Cut Naptha	Isom. Feed	Hydrotreater	Reactor Section	Sieve Section	Isom. Type
	FRESH FEED BPCD	-FRACTIONATION- BPSD	BPSD	BPSD	BPSD	BPSD	
Atlantic							
1	4,419	13,999	4,652	4,652	5,583	--	Once Thru
2	1,515	4,808	1,595	1,595	1,914	--	Once Thru
3	379	1,200	398	398	479	--	Once Thru
Total (Atlantic)	6,313	19,999	6,645	6,645	7,976	--	Once Thru
Quebec							
1	2,848	9,242	2,998	2,998	3,609	--	Once Thru
2	4,402	14.283	4,634	4,634	5,549	--	Once Thru
3	5,697	18,485	5,996	5,996	7,196	--	Once Thru
4	----	----	----	----	----	--	----
Total (Quebec)	12,947	42,010	13,628	13,628	16,354	--	Once Thru
Ontario							
1	10,951	35,008	11,527	11,527	13,800	--	Once Thru
2	7,086	22,653	7,459	7,459	8,791	--	Once Thru
3	6,442	20,593	6,781	6,781	8,178	--	Once Thru
4	7,730	24,712	8,137	8,137	9,916	--	Once Thru
5	----	----	----	----	----	--	----
Total (Ontario)	32,209	102,966	33,904	33,904	40,685	--	Once Thru
Western							
1	----	----	----	----	----	--	----
2	----	----	----	----	----	--	----
3	----	----	----	----	----	--	----
4	----	----	----	----	----	--	----
5	----	----	----	----	----	--	----
6	-----	----	----	----	----	--	----
7	----	----	----	----	----	--	----
8	----	----	----	----	----	--	----
9	----	----	----	----	----	--	----
10	----	----	----	----	----	--	----
11	----	----	----	----	----	--	----
Total (Western)	----	----	----	----	----	--	----

TABLE 4-4

DETAILED SUMMARY OF REQUIRED NEW UNIT CAPACITIES

MARKET OCTANES - BASE

ISOMERIZATION UNIT

efinery #	Req'd Iso. Capacity	Full Cut Naptha	Isom. Feed	Hydrotreater	Reactor Section	Sieve Section	Isom. Type
	FRESH FEED	-FRACTIONATION-					
	BPCD	BPSD	BPSD	BPSD	BPSD	BPSD	
tlantic							
	4,419	13,294	4,652	4,652	5,583	—	Once Thru
	1,515	4,558	1,595	1,595	1,914	--	Once Thru
	379	1,139	398	398	479	--	Once Thru
otal (Atlantic)	6,313	18,991	6,645	6,645	7,976	--	Once Thru
uebec							
	-	-	-	-	-	--	-
	4,274	14,103	4,499	4,499	5,456	--	Once Thru
	5,601	18,480	5,896	5,896	7,082	—	Once Thru
	4,864	16,049	5,120	5,120	6,080	—	Once Thru
otal (Quebec)	14,739	48,632	15,515	15,515	18,618	--	Once Thru
ntario							
	11,110	35,077	11,694	11,694	14,053	--	Once Thru
	7,103	22,426	7,477	7,477	8,953	—	Once Thru
	----	----	----	----	----	--	----
	----	----	----	----	----	--	----
	----	------	----	----	----	--	----
otal (Ontario)	18,213	57,503	19,171	19,171	23,006	--	Once Thru
estern							
	----	----	----	----	----	--	----
	----	----	----	----	----	--	----
	----	----	----	----	----	--	----
	----	----	----	----	----	--	----
	----	----	----	----	----	--	----
	------	----	----	----	----	--	----
	----	----	----	----	----	--	----
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	----	----	----	----	----	--	----
	----	----	----	----	----	--	----
	----	----	----	----	----	--	----
tal (Western)	----	----	----	----	----	--	----

TABLE 4-5

DETAILED SUMMARY OF REQUIRED NEW UNIT CAPACITIES

MARKET OCTANES - CASE1

ISOMERIZATION UNIT

Refinery #	Req'd Iso. Capacity	Full Cut Naptha	Isom. Feed	Hydrotreater	Reactor Section	Sieve Section	Isom. Type
	FRESH FEED BPCD	-FRACTIONATION- BPSD	BPSD	BPSD	BPSD	BPSD	
Atlantic							
1	4,419	13,284	4,652	4,652	5,583	5,583	TOTAL
2	1,515	4,555	1,595	1,595	1,914	1,914	TOTAL
3	379	1,138	398	398	479	479	TOTAL
Total (Atlantic)	6,313	18,977	6,645	6,645	7,976	7,976	TOTAL
Quebec							
1	3,706	11,657	3,901	3,901	4,681	4,681	TOTAL
2	4,274	13,587	4,499	4,499	5,456	5,456	TOTAL
3	5,601	17,636	5,896	5,896	7,082	7,082	TOTAL
4	4,864	15,140	5,120	5,120	6,080	6,080	TOTAL
Total (Quebec)	18,445	58,020	19,416	19,416	23,299	23,299	TOTAL
Ontario							
1	11,110	35,649	11,694	11,694	14,053	—	ONCE THRU
2	7,103	22,711	7,477	7,477	8,953	—	ONCE THRU
3	6,511	20,628	6,854	6,854	8,132	—	ONCE THRU
4	7,859	25,012	8,272	8,272	9,860	—	ONCE THRU
5	8,083	26,303	8,509	8,509	10,369	—	ONCE THRU
Total (Ontario)	40,666	130,303	42,806	42,806	51,367	—	ONCE THRU
Western							
1	1,705	7,739	1,795	1,795	2,154	—	ONCE THRU
2	1,817	8,246	1,913	1,913	2,296	—	ONCE THRU
3	447	2,030	471	471	565	—	ONCE THRU
4	1,985	9,007	2,089	2,089	2,507	—	ONCE THRU
5	895	4,060	942	942	1,130	—	ONCE THRU
6	1,062	4,821	1,118	1,118	1,342	—	ONCE THRU
7	2,069	9,388	2,178	2,178	2,613	—	ONCE THRU
8	5,955	27,023	6,268	6,268	7,522	—	ONCE THRU
9	8,303	37,679	8,740	8,740	10,489	—	ONCE THRU
10	2,320	10,530	2,442	2,442	2,931	—	ONCE THRU
11	1,397	6,344	1,472	1,472	1,766	—	ONCE THRU
Total (Western)	27,957	126,867	29,428	29,428	35,315	—	ONCE THRU

TABLE 4-6

CAPACITY VS ONSITE COST

BPSD VS $MM

	1200	3000	5000	10000	15000
Fractionation	0.74	1.34	1.88	2.95	3.84
Hydrotreating	1.75	3.17	4.42	6.94	9.03
- Catalyst	.02	0.057	0.095	.19	0.29
Once Thru Isomerization	3.50	6.35	8.85	13.88	18.07
- Catalyst	.25	0.624	1.04	2.08	3.12
Total Isomerization	8.37	15.19	21.17	33.22	43.24
- Catalyst	.44	1.1	1.84	3.68	5.52
Aromatics Extraction	4.31	7.82	10.91	17.12	22.27

TABLE 4-7

SUMMARY OF ESTIMATES

CGSB OCTANES

($ MM)

	Isomerization					
	Fractionation	Hydrotreating	Isom Unit	Offsites	Crude Inventory	Total Capital Cost
ATL-BASE	-	-	-	-	-	-
ATL-CASE	3.42	8.21	19.56	8.78	0.43	40.40
ATL-DIF$	3.42	8.21	19.56	8.78	0.43	40.40
QUE-BASE	-	-	-	-	-	-
QUE-CASE	5.26	12.61	31.24	13.63	1.67	64.41
QUE-DIF$	5.26	12.61	31.24	13.63	1.67	64.41
ONT-BASE	-	-	-	-	-	-
ONT-CASE	10.55	25.44	64.35	27.37	1.92	129.63
ONT-DIF$	10.55	25.44	64.35	27.37	1.92	129.63
WES-BASE	-	-	-	-	-	-
WES-CASE	-	-	-	-	1.08	1.08
WES-DIF$	-	-	-	-	1.08	1.08
CANADA-BASE	-	-	-	-	-	-
CANADA-CASE	19.23	46.26	115.15	49.78	5.1	235.52
CANADA-DIF$	19.23	46.26	115.15	49.78	5.1	235.52

TABLE 4-8

SUMMARY OF ESTIMATES

MARKET OCTANES

(\$ MM)

	Isomerization					
	Fractionation	Hydrotreating	Isom Unit	Offsites	Crude Inventory	Total Capital Cost
ATL-BASE	3.42	8.21	19.56	8.78	-	39.97
ATL-CASE	3.42	8.21	45.64	16.19	-	73.46
ATL-DIF$	-	-	26.08	7.41	-	33.49
QUE-BASE	5.77	13.84	34.38	14.93	-	68.92
QUE-CASE	7.36	17.67	103.84	35.89	0.73	165.49
QUE-DIF$	1.59	3.83	69.46	20.96	0.73	96.57
ONT-BASE	5.7	13.78	35.25	14.71	-	69.44
ONT-CASE	13.26	32.03	81.04	34.46	2.02	162.81
ONT-DIF$	7.56	18.25	45.79	19.75	2.02	93.37
WES-BASE	-	-	-	-	-	-
WES-CASE	13.24	31.80	76.77	34.13	0.4	156.34
WES-DIF$	13.24	31.80	76.77	34.13	0.4	156.34
CANADA-BASE	14.89	35.83	89.19	38.42	-	178.33
CANADA-CASE	37.28	89.71	307.29	120.67	3.15	558.1
CANADA-DIF$	22.39	53.88	218.10	82.25	3.15	379.77

TABLE 4-9

SUMMARY OF INVESTMENT COSTS

($ MM)

REGION: CANADA

REGION	CGSB OCTANES BASE	CGSB OCTANES CASE1	MARKET OCTANES BASE	MARKET OCTANES CASE1
ATLANTIC	-	40.40	39.97	73.46
QUEBEC	-	64.41	68.92	165.49
ONTARIO	-	129.63	69.44	162.81
WESTERN	-	1.08	-	156.34
TOTAL CANADA	-	235.52	178.33	558.1

TABLE 4-10

ESTIMATE DETAIL

($ MM)

REGION: Atlantic

Refinery #1

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	1.79	1.79	1.79
1.2 Hydrotreater	-	4.22	4.22	4.22
--Catalyst	-	.09	.09	0.09
1.3 Once Thru Isom.(reactor sect.)	-	9.51	9.51	--
--Catalyst	-	1.16	1.16	--
1.4 Total Isom. (reactor&sieve sect.	-	--	--	22.74
--Catalyst	-	--	--	2.05
Total Onsite Capital Cost:		16.77	16.77	30.89
2. Total Offsite Capital Cost (30%)		4.66	4.66	8.63
TOTAL INVESTMENT		21.42	21.42	39.52

TABLE 4-11

ESTIMATE DETAIL

($ MM)

REGION: ATLANTIC REFINERY #2

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	.89	.89	0.89
1.2 Hydrotreater	-	2.10	2.10	2.10
--Catalyst	-	.03	.03	.03
1.3 Once Thru Isom.(reactor sect.)	-	4.74	4.74	--
--Catalyst	-	.40	.40	--
1.4 Total Isom. (reactor&sieve sec.)	-	--	--	11.34
--Catalyst	-	--	--	.7
Total Onsite Capital Cost:	-	8.17	8.17	15.07
2. Total Offsite Capital Cost (30%)	-	2.32	2.32	4.3
TOTAL INVESTMENT	-	10.49	10.49	19.38

TABLE 4-12

ESTIMATE DETAIL

($ MM)

REGION: ATLANTIC

REFINERY #3

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	0.74	0.74	0.74
1.2 Hydrotreater	-	1.75	1.75	1.75
--Catalyst	-	0.02	0.02	0.02
1.3 Once Thru Isom.(reactor sect.)	-	3.50	3.50	--
--Catalyst	-	.25	.25	--
1.4 Total Isom. (reactor&sieve sec.)	-	--	--	8.37
--Catalyst	-	--	--	.44
Total Onsite Capital Cost:	-	6.26	6.26	11.33
2. Total Offsite Capital Cost (30%)	-	1.80	1.80	3.26
TOTAL INVESTMENT	-	8.06	8.06	14.59

TABLE 4-13

ESTIMATE DETAIL

($ MM)

REGION: QUEBEC

REFINERY #1

	CGSB Octanes		Market Octanes	
	Base	Casel	Base	Casel
1. Isomerization				
1.1 Fractionation	-	1.35	--	1.59
1.2 Hydrotreater	-	3.17	--	3.76
--Catalyst	-	.06	--	0.07
1.3 Once Thru Isom.(reactor sect.)	-	7.16	--	--
--Catalyst	-	.75	--	--
1.4 Total Isom. (reactor&sieve sec.)	-	--	--	20.28
--Catalyst	-	--	--	1.72
Total Onsite Capital Cost:	-	12.49	--	27.43
2. Total Offsite Capital Cost (30%)	-	3.5	--	7.69
TOTAL INVESTMENT	-	15.99	--	35.13

TABLE 4-14

ESTIMATE DETAIL

($ MM)

REGION: QUEBEC

REFINERY # 2

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	1.79	1.76	1.76
1.2 Hydrotreater	-	4.21	4.13	4.13
--Catalyst	-	.09	.09	0.09
1.3 Once Thru Isom.(reactor sect.)	-	9.47	9.37	--
--Catalyst	-	1.15	1.13	--
1.4 Total Isom. (reactor&sieve sec.)	-	--	--	22.41
--Catalyst	-	--	--	2.01
Total Onsite Capital Cost:	-	16.71	16.47	30.38
2. Total Offsite Capital Cost (30%)	-	4.64	4.57	8.49
TOTAL INVESTMENT	-	21.35	21.04	38.87

TABLE 4-15

ESTIMATE DETAIL

($ MM)

REGION: QUEBEC

REFINERY #3

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	2.12	2.1	2.1
1.2 Hydrotreater	-	4.97	4.92	4.92
--Catalyst	-	.11	.11	.11
1.3 Once Thru Isom.(reactor sect.)	-	11.21	11.10	--
--Catalyst	-	1.50	1.47	--
1.4 Total Isom. (reactor&sieve sec.)	-	--	--	28.27
--Catalyst	-	--	--	2.87
Total Onsite Capital Cost:	-	19.91	19.7	38.26
2. Total Offsite Capital Cost (30%)	-	5.49	5.43	10.58
TOTAL INVESTMENT	-	25.4	25.13	48.84

TABLE 4-16

ESTIMATE DETAIL

($ MM)

REGION: QUEBEC

REFINERY #4

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	--	1.91	1.91
1.2 Hydrotreater	-	--	4.49	4.49
--Catalyst	-	--	.10	.10
1.3 Once Thru Isom.(reactor sect.)	-	--	10.05	--
--Catalyst	-	--	1.26	--
1.4 Total Isom. (reactor&sieve sec.)	-	--	--	24.04
--Catalyst	-	--	--	2.24
Total Onsite Capital Cost:	-	--	17.81	32.77
2. Total Offsite Capital Cost (30%)	-	--	4.93	9.13
TOTAL INVESTMENT	-	--	22,74	41.90

TABLE 4-17

ESTIMATE DETAIL

($ MM)

REGION: ONTARIO **REFINERY #1**

	CGSB Octanes		Market Octanes	
	Base	Casel	Base	Casel
1. Isomerization				
1.1 Fractionation	-	3.23	3.26	3.26
1.2 Hydrotreater	-	7.61	7.68	7.68
--Catalyst	-	.22	.22	.22
1.3 Once Thru Isom.(reactor sect.)	-	17.12	17.32	17.32
--Catalyst	-	2.87	3.15	2.92
1.4 Total Isom. (reactor&sieve sec.)	-	--	--	--
--Catalyst	-	--	--	--
Total Onsite Capital Cost:	-	31.05	31.41	31.41
2. Total Offsite Capital Cost (30%)	-	8.39	8.48	8.48
TOTAL INVESTMENT	-	39.44	39.89	39.89

TABLE 4-18

ESTIMATE DETAIL

($ MM)

REGION: ONTARIO **REFINERY #2**

	CGSB Octanes		Market Octanes	
	Base	Casel	Base	Casel
1. Isomerization				
1.1 Fractionation	-	2.44	2.44	2.44
1.2 Hydrotreater	-	5.73	5.74	5.74
--Catalyst	-	.14	.14	.14
1.3 Once Thru Isom.(reactor sect.)	-	12.77	12.92	12.92
--Catalyst	-	1.83	1.86	1.86
1.4 Total Isom. (reactor&sieve sec.)	-	--	--	--
--Catalyst	-	--	-	--
Total Onsite Capital Cost:	-	22.92	23.11	23.11
2. Total Offsite Capital Cost (30%)	-	6.28	6.33	6.33
TOTAL INVESTMENT	-	29.19	29.44	29.44

TABLE 4-19

ESTIMATE DETAIL

($ MM)

REGION: ONTARIO REFINERY # 3

		CGSB Octanes		Market Octanes	
		Base	Casel	Base	Casel
1.	Isomerization				
1.1	Fractionation	-	2.29	--	2.3
1.2	Hydrotreater	-	5.39	--	5.43
	--Catalyst	-	.13	--	.13
1.3	Once Thru Isom.(reactor sect.)	-	12.19	--	12.14
	--Catalyst	-	1.70	--	1.69
1.4	Total Isom. (reactor&sieve sec.)	-	--	--	--
	--Catalyst	-	--	--	--
	Total Onsite Capital Cost:	-	21.7	--	21.6-9
2.	Total Offsite Capital Cost (30%)	-	5.96	--	5.9-6
	TOTAL INVESTMENT	-	27.65	--	27.6-5

TABLE 4-20

ESTIMATE DETAIL

($ MM)

REGION: ONTARIO **REFINERY # 4**

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	2.59	--	2.6
1.2 Hydrotreater	-	6.07	--	6.13
--Catalyst	-	.15	--	.16
1.3 Once Thru Isom.(reactor sect.)	-	13.81	--	13.76
--Catalyst	-	2.06	--	2.05
1.4 Total Isom. (reactor&sieve sec.)	-	--	--	--
--Catalyst	-	--	--	--
Total Onsite Capital Cost:	-	24.67	--	24.71
2. Total Offsite Capital Cost (30%)	-	6.74	--	6.75
TOTAL INVESTMENT	-	31.41	--	31.46

TABLE 4-21

ESTIMATE DETAIL

($ MM)

REGION: ONTARIO

REFINERY #5

	CGSB Octanes		Market Octanes	
	Base	Casel	Base	Casel
1. Isomerization				
1.1 Fractionation	-	-	--	2.66
1.2 Hydrotreater	-	-	--	6.24
--Catalyst	-	-	--	0.16
1.3 Once Thru Isom.(reactor sect.)	-	-	--	14.22
--Catalyst	-	-	--	2.16
1.4 Total Isom. (reactor&sieve sec.)	-	-	--	--
--Catalyst	-	-	--	--
Total Onsite Capital Cost:	-	-	--	25.44
2. Total Offsite Capital Cost (30%)	-	-	--	6.94
TOTAL INVESTMENT	-	-	--	32.37

TABLE 4-22

ESTIMATE DETAIL

($ MM)

REGION: WESTERN

REFINERY # 1

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	-	-	0.96
1.2 Hydrotreater	-	-	-	2.27
--Catalyst	-	-	-	0.03
1.3 Once Thru Isom.(reactor sect.)	-	-	-	5.12
--Catalyst	-	-	-	.45
1.4 Total Isom. (reactor&sieve sec.)	-	-	-	--
--Catalyst	-	-	-	--
Total Onsite Capital Cost:	-	-	-	8.84
2. Total Offsite Capital Cost (30%)	-	-	-	2.51
TOTAL INVESTMENT	-	-	-	11.35

TABLE 4-23

ESTIMATE DETAIL

($ MM)

REGION: WESTERN

REFINERY # 2

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	-	-	1.0
1.2 Hydrotreater	-	-	-	2.37
--Catalyst	-	-	-	.04
1.3 Once Thru Isom.(reactor sect.)	-	-	-	5.34
--Catalyst	-	-	-	.48
1.4 Total Isom. (reactor&sieve sec.)	-	-	-	--
--Catalyst	-	-	-	--
Total Onsite Capital Cost:	-	-	-	9.22
2. Total Offsite Capital Cost (30%)	-	-	-	2.61
TOTAL INVESTMENT	-	-	-	11.84

TABLE 4-24

ESTIMATE DETAIL

($ MM)

REGION: WESTERN REFINERY # 3

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	-	-	.74
1.2 Hydrotreater	-	-	-	1.75
--Catalyst	-	-	-	.02
1.3 Once Thru Isom.(reactor sect.)	-	-	-	3.50
--Catalyst	-	-	-	.25
1.4 Total Isom. (reactor&sieve sec.)	-	-	-	--
--Catalyst	-	-	-	--
Total Onsite Capital Cost:	-	-	-	6.26
2. Total Offsite Capital Cost (30%)	-	-	-	1.80
TOTAL INVESTMENT	-	-	-	8.06

TABLE 4-25

ESTIMATE DETAIL

($ MM)

REGION: WESTERN

REFINERY # 4

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	-	-	1.07
1.2 Hydrotreater	-	-	-	2.51
--Catalyst	-	-	-	.04
1.3 Once Thru Isom.(reactor sect.)	-	-	-	5.65
--Catalyst	-	-	-	.52
1.4 Total Isom. (reactor&sieve sec.)	-	-	-	--
--Catalyst	-	-	-	--
Total Onsite Capital Cost:	-	-	-	9.79
2. Total Offsite Capital Cost (30%)	-	-	-	2.77
TOTAL INVESTMENT	-	-	-	12.55

TABLE 4-26

ESTIMATE DETAIL

($ MM)

REGION: WESTERN **REFINERY # 5**

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	-	-	0.74
1.2 Hydrotreater	-	-	-	1.75
--Catalyst	-	-	-	.02
1.3 Once Thru Isom.(reactor sect.)	-	-	-	3.50
--Catalyst	-	-	-	.25
1.4 Total Isom. (reactor&sieve sec.)	-	-	-	--
--Catalyst	-	-	-	--
Total Onsite Capital Cost:	-	-	-	6.26
2. Total Offsite Capital Cost (30%)	-	-	-	1.80
TOTAL INVESTMENT	-	-	-	8.06

TABLE 4-27

ESTIMATE DETAIL

($ MM)

REGION: WESTERN

REFINERY # 6

		CGSB Octanes		Market Octanes	
		Base	Casel	Base	Casel
1.	Isomerization				
1.1	Fractionation	-	-	-	0.74
1.2	Hydrotreater	-	-	-	1.75
	--Catalyst	-	-	-	0.02
1.3	Once Thru Isom. (reactor sect.)	-	-	-	3.76
	--Catalyst	-	-	-	0.28
1.4	Total Isom. (reactor&sieve sec.)	-	-	-	--
	--Catalyst	-	-	-	--
	Total Onsite Capital Cost:	-	-	-	6.56
2.	Total Offsite Capital Cost (30%)	-	-	-	1.88
	TOTAL INVESTMENT	-	-	-	8.43

TABLE 4-28

ESTIMATE DETAIL

($ MM)

REGION: WESTERN

REFINERY #7

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	-	-	1.1
1.2 Hydrotreater	-	-	-	2.58
--Catalyst	-	-	-	0.04
1.3 Once Thru Isom.(reactor sect.)	-	-	-	5.80
--Catalyst	-	-	-	0.54
1.4 Total Isom. (reactor&sieve sec.)	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	10.06
2. Total Offsite Capital Cost (30%)	-	-	-	2.84
TOTAL INVESTMENT	-	-	-	12.90

TABLE 4-29

ESTIMATE DETAIL

($ MM)

REGION: WESTERN REFINERY #8

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	-	-	2.18
1.2 Hydrotreater	-	-	-	5.12
--Catalyst	-	-	-	.12
1.3 Once Thru Isom. (reactor sect.)	-	-	-	11.54
--Catalyst	-	-	-	1.56
1.4 Total Isom. (reactor&sieve sec.)	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	20.52
2. Total Offsite Capital Cost (30%)	-	-	-	5.65
TOTAL INVESTMENT	-	-	-	26.17

TABLE 4-30

ESTIMATE DETAIL

($ MM)

REGION: WESTERN

REFINERY #9

	CGSB Octanes		Market Octanes	
	Base	Casel	Base	Casel
1. Isomerization				
1.1 Fractionation	-	-	-	2.7
1.2 Hydrotreater	-	-	-	6.35
--Catalyst	-	-	-	.17
1.3 Once Thru Isom.(reactor sect.)	-	-	-	14.32
--Catalyst	-	-	-	2.18
1.4 Total Isom. (reactor&sieve sec.)	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	25.72
2. Total Offsite Capital Cost (30%)	-	-	-	7.01
TOTAL INVESTMENT	-	-	-	32.74

TABLE 4-31

ESTIMATE DETAIL

($ MM)

REGION: WESTERN

REFINERY #10

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	-	-	1.17
1.2 Hydrotreater	-	-	-	2.77
--Catalyst	-	-	-	.05
1.3 Once Thru Isom.(reactor sect.)	-	-	-	6.25
--Catalyst	-	-	-	.61
1.4 Total Isom. (reactor&sieve sec.)	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	10.86
2. Total Offsite Capital Cost (30%)	-	-	-	3.06
TOTAL INVESTMENT	-	-	-	13.93

TABLE 4-32

ESTIMATE DETAIL

($ MM)

REGION: WESTERN

REFINERY #11

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
1. Isomerization				
1.1 Fractionation	-	-	-	0.84
1.2 Hydrotreater	-	-	-	2.00
--Catalyst	-	-	-	.03
1.3 Once Thru Isom.(reactor sect.)	-	-	-	4.50
--Catalyst .37	-	-	-	-
1.4 Total Isom. (reactor&sieve sec.)	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	7.74
2. Total Offsite Capital Cost (30%)	-	-	-	2.20
TOTAL INVESTMENT	-	-	-	9.94

4.2 Operating Costs

4.2.1 Basis of Estimate

Variations in refinery operating costs for removing MMT have been calculated for each region. These costs have been derived from an analysis of nine basic categories, namely:

- Power
- Fuel and Steam
- Additional Crude Oil
- Imported i-C-4
- Credit for extra HFO production
- Catalyst replacement
- Wages for extra refinery personnel
- Credit for reduced lead additive consumption
- Credit for reduced MMT consumption

Table 2-17 lists the pertinent data developed for regional feedstock product and utility costs.

Fuel and Steam Costs

All fuel used for processing requirements is assumed to be supplied primarily by the fuel gas generated within the refinery and supplemented by heavy fuel oil if necessary. However, for calculation and evaluation purposes, the price of an equivalent quantity of HFO is credited.

Catalyst Replacement Costs

The catalyst replacement cost calculations are based on the capacities of the additional units. The cost is taken to be one-third of the initial catalyst charge spread over one-and-one-half years.

Extra Refinery Personnel

For each refinery, the following additional personnel are considered necessary to operate the additional units irrespective of their capacities.

Isomerization Unit	No./Shift	No. Per Day
(once through unit)		
Process Operators	1	4-1/2
Support Staff		1 (equivalent)
-- laboratory technician		
-- utility operator		
-- maintenance staff		
-- clerk		
-- process engineer		
TOTAL		5-1/2
Isomerization Unit (Total ISOM Unit)		
Process Operators	2	9
Support Staff		2 (equivalent)
-- laboratory technician		
-- utility operator		
-- maintenance staff		
-- clerk		
-- process engineer		
TOTAL		11
Aromatics Extraction		
Process Operators	1	4-1/2
Support Staff		1 (equivalent)
-- laboratory technician		
-- utility operator		
-- maintenance staff		
-- clerk		
-- process engineer		
TOTAL		5-1/2

Process Operators

The process operators are responsible for the day to day operation and control of the process units and they will be stationed in the process control room.

Support Staff

The following support staff are deemed necessary on a part time basis.

Category	Function
Laboratory Technician	To conduct routine sample analysis to ensure product quality.
Utility Operator	Responsible for adequate supply of utilities such as water, steam, chemicals, etc.
Maintenance Staff	Responsible for repair to mechanical, electrical and instrumentation equipment on a daily basis.
Clerk	Supplement the office staff and perform routine administrative and clerical duties.
Process Engineer	Responsible for overseeing and coordinating the units on a daily basis. (S)he would monitor process plant operation, conduct test runs and write technical reports suggesting optimum operating modes.

The qualifications needed for these personnel are summarized below.

Personnel Category	Qualifications
Process Operator	High School Education plus practical engineering apprenticeship.
Utility Operator	High School education plus practical engineering apprenticeship.
Maintenance Engineer	Graduate Engineer.
Maintenance Operator	High School education plus practical engineering apprenticeship.
Laboratory Technician	High School education plus chemistry bent
Clerk	High School education
Process Engineer	Degree in chemical engineering

The process operators would be on shift work whereas all other personnel on the list would operate on a daily basis. The average remuneration for each personnel classification has not been subdivided due to lack of readily available data. Statscan publish an average figure relating to process type operators and it is considered fairly representative of the average remuneration applicable to the general classification mentioned above. For study purposes a figure of $20.00 per hour was used to cover wages and payroll burden.

Note that it takes the equivalent of 4-1/2 men on the payroll for each shift job.

The control and operation of the new process units is assumed to be integrated and they would be physically located in one area of the refinery. The personnel requirements are considered to remain the same with the addition of isomerization, or aromatics extraction units, for the purposes of the study.

The total process incremental operating cost variations were calculated for each case and all results are reported in Table 4-33 to 4-46. These figures exclude any capital depreciation. Table 4-46 summarizes the overall incremental operating costs to produce MMT FREE gasoline (90/10 split gasoline).

TABLE 4 - 33

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: ATLANTIC

BASE: CGSB OCTANES (18Mg/L Mn 70/30 SPLIT)

CASE1: CGSB OCTANES (0 MMT 90/10 SPLIT)

1. POWER COST	1377.43
2. FUEL & STEAM COSTS	-2642.47
3. COST OF ADDITIONAL CRUDE	14137
4. COST OF IMPORTED i-C4	-
5. CREDIT FOR EXTRA HFO PROD'N	-
6. CATALYSTS REPLACEMENTS COSTS*	1109
7. WAGES*	2640
8. CREDIT FOR LEAD ADDITIVES	-1709
9. CREDIT FOR MMT	-4815
TOTAL $/CD	10096.96
TOTAL $MM/YR	3.69

* BASED ON THE FOLLOWING

3 ISOMERIZATION UNITS (ONCE THROUGH) ADDITIONAL TO BASE CASE

TABLE 4 - 34

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: QUEBEC
BASE: CGSB OCTANES (18 Mg/L Mn 70/30 SPLIT)
CASE1: CGSB OCTANES (0 MMT 90/10 SPLIT)

1.	POWER COST	1541.92
2.	FUEL & STEAM COSTS	-16619.8
3.	COST OF ADDITIONAL CRUDE	55754
4.	COST OF IMPORTED i-C4	-
5.	CREDIT FOR EXTRA HFO PROD'N	-
6.	CATALYSTS REPLACEMENTS COSTS*	2230
7.	WAGES*	2640
8.	CREDIT FOR LEAD ADDITIVES	-3594
9.	CREDIT FOR MMT	-9807
	TOTAL $/CD	32145.12
	TOTAL $MM/YR	11.73

* BASED ON THE FOLLOWING

3 ISOMERIZATION UNITS (ONCE THROUGH) ADDITIONAL TO BASE CASE

TABLE 4 - 35

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: ONTARIO
BASE: CGSB OCTANES (18 Mg/L Mn 70/30 SPLIT)
CASE1: CGSB OCTANES (0 MMT 90/10 SPLIT)

1. POWER COST	3863.17
2. FUEL & STEAM COSTS	-13395.6
3. COST OF ADDITIONAL CRUDE	63889
4. COST OF IMPORTED i-C4	-12295
5. CREDIT FOR EXTRA HFO PROD'N	-
6. CATALYSTS REPLACEMENTS COSTS*	5551
7. WAGES*	3520
8. CREDIT FOR LEAD ADDITIVES	-6953
9. CREDIT FOR MMT	-18968
TOTAL $/CD	25211.57
TOTAL $MM/YR	9.20

* BASED ON THE FOLLOWING

4 ISOMERIZATION UNITS (ONCE THROUGH) ADDITIONAL TO BASE CASE

TABLE 4 - 36

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: WESTERN

BASE: CGSB OCTANES (18 Mg/L Mn 70/30 SPLIT)

CASE1: CGSB OCTANES (0 MMT 90/10 SPLIT)

1.	POWER COST	263.02
2.	FUEL & STEAM COSTS	-34945.6
3.	COST OF ADDITIONAL CRUDE	35956
4.	COST OF IMPORTED i-C4	-3749
5.	CREDIT FOR EXTRA HFO PROD'N	-
6.	CATALYSTS REPLACEMENTS COSTS*	-
7.	WAGES*	-
8.	CREDIT FOR LEAD ADDITIVES	-8179
9.	CREDIT FOR MMT	-23068
	TOTAL $/CD	-33722.58
	TOTAL $MM/YR	-12.31

* BASED ON THE FOLLOWING

0 ISOMERIZATION UNITS (ONCE THROUGH) ADDITIONAL TO BASE CASE

TABLE 4 - 37

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: ATLANTIC
BASE: MARKET OCTANES (18 MG/L Mn 70/30 SPLIT)
CASE1: MARKET OCTANES (0 MMT 90/10 SPLIT)

1.	POWER COST	233.71
2.	FUEL & STEAM COSTS	1955.1
3.	COST OF ADDITIONAL CRUDE	-567
4.	COST OF IMPORTED i-C4	-
5.	CREDIT FOR EXTRA HFO PROD'N	-
6.	CATALYSTS REPLACEMENTS COSTS*	780
7.	WAGES*	2640
8.	CREDIT FOR LEAD ADDITIVES	-1709
9.	CREDIT FOR MMT	-4815
	TOTAL $/CD	-1482.19
	TOTAL $MM/YR	-0.54

* BASED ON THE FOLLOWING

3 ISOMERIZATION UNITS (SIEVE SECTION ONLY) ADDITIONAL TO BASE CASE

TABLE 4 - 38

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: QUEBEC

CASE: Market OCTANES (18 MG/L Mn 70/30 SPLIT)

BASE: Market OCTANES (0 MMT 90/10 SPLIT)

1.	POWER COST	1108.55
2.	FUEL & STEAM COSTS	4440.3
3.	COST OF ADDITIONAL CRUDE	24424
4.	COST OF IMPORTED i-C4	-
5.	CREDIT FOR EXTRA HFO PROD'N	-
6.	CATALYSTS REPLACEMENTS COSTS*	2907
7.	WAGES*	4400
8.	CREDIT FOR LEAD ADDITIVES	-3594
9.	CREDIT FOR MMT	-9807
	TOTAL $/CD	23878.85
	TOTAL $MM/YR	8.72

* BASED ON THE FOLLOWING

1 + 3 ISOMERIZATION UNITS (1 TOTAL ISOMERIZATION UNIT) ADDITIONAL TO BASE CASE
(3 SIEVE SECTIONS) ADDITIONAL TO BASE CASE
ADDITIONAL TO BASE CASE

TABLE 4 - 39

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: ONTARIO
BASE: MARKET OCTANES (18 Mg/L Mn 70/30 SPLIT)
CASE1: MARKET OCTANES (0 MMT 90/10 SPLIT)

1. POWER COST	4058.47
2. FUEL & STEAM COSTS	11103.4
3. COST OF ADDITIONAL CRUDE	67299
4. COST OF IMPORTED i-C4	-11903
5. CREDIT FOR EXTRA HFO PROD'N	-
6. CATALYSTS REPLACEMENTS COSTS*	3870
7. WAGES*	2640
8. CREDIT FOR LEAD ADDITIVES	-6953
9. CREDIT FOR MMT	-18968
TOTAL $/CD	52026.87
TOTAL $MM/YR	18.99

* BASED ON THE FOLLOWING

3 ISOMERIZATION UNITS (ONCE THROUGH) ADDITIONAL TO BASE CASE

TABLE 4 - 40

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: WESTERN
BASE: MARKET OCTANES (18 Mg/L Mn 70/30 SPLIT)
CASE1: MARKET OCTANES (0 MMT 90/10 SPLIT)

1.	POWER COST	2756.68
2.	FUEL & STEAM COSTS	-17769
3.	COST OF ADDITIONAL CRUDE	14425
4.	COST OF IMPORTED i-C4	-4722
5.	CREDIT FOR EXTRA HFO PROD'N	-
6.	CATALYSTS REPLACEMENTS COSTS*	4820
7.	WAGES*	9680
8.	CREDIT FOR LEAD ADDITIVES	-8179
9.	CREDIT FOR MMT	-23068
	TOTAL $/CD	-22056.32
	TOTAL $MM/YR	-8.05

* BASED ON THE FOLLOWING

11 ISOMERIZATION UNITS (ONCE THROUGH) ADDITIONAL TO BASE CASE

TABLE 4-41

ANNUAL OPERATING COST

REGION: ATLANTIC

	CGSB Octanes		Market Octanes	
	Base	Casel	Base	Casel
CAPITAL EQUIPMENT COST - $ MM/YR				
Isomerization Units	-	31.19	31.19	57.27
Offsites	-	8.78	8.78	16.19
Crude Inventory	-	0.43	-	-
Total	-	40.40	39.97	73.46

ANNUAL OPERATING COST $ MM/YR

	CGSB Octanes		Market Octanes	
	Base	Casel	Base	Casel
Capital Charges (25%)	-	10.10	9.993	18.365
Insurance (0.5%)	-	0.202	0.200	0.367
Local Taxes (1.0%)	-	0.404	0.398	0.734
Maintenance (5.5%	-	2.222	2.198	4.041
Process Operating Cost (Incremental Total)	-	3.69	-	-0.54
Total	-	16.618	12.788	22.966
Incremental Annual Operating Cost (Casel - BASE)	16.618		10.178	

TABLE 4-42

ANNUAL OPERATING COST

REGION: QUEBEC

	CGSB Octanes		Market Octanes	
	Base	Casel	Base	Casel
CAPITAL EQUIPMENT COST - $ MM/YR				
Isomerization Units	-	49.1	53.99	128.87
Offsites	-	13.63	14.93	35.89
Crude Inventory	-	1.67	-	0.73
Total	-	64.41	68.92	165.49

ANNUAL OPERATING COST $ MM/YR

	CGSB Octanes		Market Octanes	
	Base	Casel	Base	Casel
Capital Charges (25%)	-	16.103	17.23	41.373
Insurance (0.5%)	-	0.322	0.345	0.827
Local Taxes (1.0%)	-	0.6441	0.689	1.655
Maintenance (5.5%	-	3.543	3.791	9.102
Process Operating Cost (Incremental Total)	-	11.73	-	8.72
Total	-	32.342	22.055	61.677
Incremental Annual Operating Cost (Casel - BASE)	32.342		39.622	

TABLE 4-43

ANNUAL OPERATING COST

REGION: ONTARIO

	CGSB Octanes		Market Octanes	
	Base	Casel	Base	Casel
CAPITAL EQUIPMENT COST - $ MM/YR				
Isomerization Units	-	100.34	54.73	126.33
Offsites	-	27.37	14.71	34.46
Crude Inventory	-	1.92	-	2.02
Total	-	129.63	69.44	162.81

ANNUAL OPERATING COST $ MM/YR

	CGSB Octanes		Market Octanes	
	Base	Casel	Base	Casel
Capital Charges (25%)	-	32.408	17.36	40.7
Insurance (0.5%)	-	0.648	0.347	0.814
Local Taxes (1.0%)	-	1.296	0.694	1.628
Maintenance (5.5%	-	7.130	3.819	8.955
Process Operating Cost (Incremental Total)	-	9.2	-	18.99
Total	-	50.682	22.22	71.087
Incremental Annual Operating Cost (Casel - BASE)	50.682		48.867	

TABLE 4-44

ANNUAL OPERATING COST

REGION: WESTERN

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
CAPITAL EQUIPMENT COST - $ MM/YR				
Isomerization Units	-	-	-	121.81
Offsites	-	-	-	34.13
Crude Inventory	-	1.08	-	0.4
Total	-	1.08	-	156.34

ANNUAL OPERATING COST $ MM/YR

	CGSB Octanes		Market Octanes	
	Base	Case1	Base	Case1
Capital Charges (25%)	-	0.27	-	39.085
Insurance (0.5%)	-	0.005	-	0.7817
Local Taxes (1.0%)	-	0.011	-	1.5634
Maintenance (5.5%	-	0.059	-	8.599
Process Operating Cost (Incremental Total)	-	-12.31	-	-8.05
Total	-	-11.965	-	41.979
Incremental Annual Operating Cost (Case1 - BASE)	-11.965		41.979	

TABLE 4-45

ANNUAL OPERATING COST

REGION: CANADA

	CGSB Octanes		Market Octanes	
	Base	Casel	Base	Casel
CAPITAL EQUIPMENT COST - $ MM/YR				
Isomerization Units	-	180.64	139.91	434.28
Offsites	-	49.78	38.42	120.67
Crude Inventory	-	5.1	-	3.15
Total	-	235.52	178.33	558.1

ANNUAL OPERATING COST $ MM/YR

	CGSB Octanes		Market Octanes	
	Base	Casel	Base	Casel
Capital Charges (25%)	-	58.88	44.583	139.525
Insurance (0.5%)	-	1.178	0.892	2.791
Local Taxes (1.0%)	-	2.3552	1.783	5.581
Maintenance (5.5%	-	12.955	9.808	30.695
Process Operating Cost (Incremental Total)	-	12.31	-	19.12
Total	-	87.678	57.066	197.712
Incremental Annual Operating Cost (Casel - BASE)	87.678		140.646	

TABLE 4-46

SUMMARY OF ANNUAL INCREMENTAL OPERATING COSTS

(CASE - BASE)

REGION: CANADA

REGION	CGSB OCTANES MM $/YR	MARKET OCTANES MM $/YR
ATLANTIC	16.618	10.178
QUEBEC	32.342	39.622
ONTARIO	50.682	48.867
WESTERN	-11.965	41.979
CANADA	87.678	140.646

5.0 OVERVIEW OF ALTERNATE ANTI-KNOCK BLENDING COMPONENTS

INTRODUCTION

This section presents a general overview of the various alternate anti-knock blending components, and processes that may be adopted to meet environmental legislation, that would eliminate or restrict the use of MMT and lead additives in motor gasoline.

5.1 Alternate High Octane Blending Components

Over the past decade there has been increasing interest in the use of certain alcohols and ethers as blending components in gasolines. In certain countries dependent on foreign crude, for example Brazil, the addition of these components to extend gasoline supplies has reduced the amount of imported crude needed to make motor gasoline. In other areas, notably in the U.S., legislation has been passed or is being contemplated for ecological reasons, which will eliminate or severely restrict the amount of TEL and/or MMT in gasoline. Blending components are therefore being used by some suppliers in preference to increased process severity to maintain the octane quality of gasoline.

The four most widely used compounds at the present time are methanol, ethanol, MTBE (methyl tertiary butyl ether) and TBA (Tertiary butyl alcohol). Table 5-1 shows comparable octane blending values for these materials and the octane improvements that may be expected from the addition of 5% of each in a 92 RON clear gasoline. The quantities currently being used are, for the most part, greater than this figure. By comparison 16.5 mg Mn/litre of MMT would raise the Research octane number 1.7 units.

The large volumetric increase of blending additive required to achieve a certain octane improvement will make transportation a significant, if not the controlling, factor in any assessment of the economics of producing and using these compounds in gasoline. The most attractive economic solution would be to have production at the refinery site or to be within a refining complex where transportation costs would be at a minimum.

The following brief review examines the various additives.

Methyl Alcohol - (Methanol)

Methanol in motor gasoline blends has experienced performance problems associated with vapour lock, rough idling, layer separation with inherent water, corrosion and engine wear. Atlantic Richfield Co. is now using and marketing a blend of 50:50, methanol: tertiary butyl alcohol (TBA) under the trade name Oxinol. This is claimed to reduce the problems associated with straight methanol to an acceptable level.

Pure methanol is reported to be cleaner burning and more energy efficient than either gasoline or ethanol. While most of the current methanol supply is derived from natural gas, it can be produced from coal, wood, refuse, bio-mass, or almost any carbonaceous material using available technology. Long term fleet tests using cars modified to burn pure methanol are being carried out in the U.S. as part of a program to develop a market for methanol from non petroleum sources.

Mobil Oil has developed a catalytic process named MTG which converts methanol to a mixed hydrocarbon product in the gasoline range. Considerable energy savings are possible in the production of methanol since this process can tolerate 15% water in the alcohol. A small (100 B/D) test plant has been operating satisfactorily in West Germany since December 1982 and a 14,000 B/D plant is currently under construction in New Zealand using methanol from natural gas. Completion is scheduled for 1985.

Ethyl Alcohol (Ethanol)

Ethanol derived from fermentation of grain is currently being marketed as Gasohol (10% in gasoline) in the U.S. The most ambitious current national program for the use of ethanol in motor fuels is in Brazil, where blends of up to 20% have been used. The raw material is sugar cane. Future planned developments include the production of vehicles to use straight alcohol with a 1985 goal of 5 million cars, or about two thirds of the cars on the road.

Much of the cost of ethanol is in the energy required for distillation (which varies between 28 - 43%) of the energy content of the final alcohol product. Studies have indicated that, in the Mobil process, the cost of converting ethanol to gasoline is less than the distillation costs, since the alcohol need only be concentrated to 85%. There is no indication, however, of development of this process for ethanol.

Methyl Tertiary Butyl Ether - (MTBE)

Methyl tertiary butyl either blends into motor gasoline with none of the disadvantages of either methanol or, to a lesser extent, ethanol. MTBE is produced by the combination of isobutylene and methanol over a catalyst. A number of patented processes are offered for this conversion.

The limiting component to rapid development of this compound is the supply of isobutylene. A number of plants have been built in the past few years, the largest of which obtain their isobutylene from large ethylene steam cracking plants.

In the refinery, isobutylene is in the B-B cut from fluid catalytic cracking. In most refineries this isobutylene is currently being converted into alkylate or polymer gasoline. Application of the process in Canadian refineries would have to compete for feedstock with existing upgrading processes.

Tertiary Butyl Alcohol - (TBA)

Tertiary butyl alcohol is a co-product from the manufacture of propylene oxide. A gasoline grade is being marketed by the Oxirane Corporation of Houston and is used in both the U.S. and Europe largely as the 50:50 mixture with methanol. The mixture of the two appears to solve most of the problems associated with the separate use of the light and heavy alcohols.

5.2 Processing Severity and Selectivity

As pointed out in the previous section, the use of purchased high octane blending components will be influenced largely by transportation costs. For refineries located some distance from major refining petrochemical complexes, changes to processing severity or selectivity may be the only economical means by which the octane barrels required to fulfill unleaded gasoline requirements can be met.

Table 5.2 lists representative octane numbers for typical refinery gasoline base stocks as well as those components from more selective processing. Table 5.3 shows the installed capacities of the downstream gasoline producing processing units reported for fully integrated Canadian fuel product refineries in 1983.

It must be noted that catalytic reforming is the main octane improvement process. The majority of Canadian reformers are cited as being semi-regenerative types and therefore acceptable run length will limit severity. Alkylation and polymerization capacities are sized to use the olefins available from cracking operations.

The difficulty of making blend corrections, particularly with the premium grade, is not immediately apparent from examination of the octanes of components available to make the blends. With TEL and MMT, only a small volume of additive is needed to give a 0.5 RON improvement. In an existing refinery with 100 RON as the highest available octane number, correcting an 80,000 barrel initial blend from 96 RON to 96.5 RON would require the addition of approximately 11,000 bbl of 100 RON component. For comparison purposes this same amount of correction would be obtained with only about 2,000 bbl of a 115 RON component. This would suggest that, for optimum use of the blending stocks, it may be necessary to add process equipment and storage to extract and segregate the mixed aromatic fractions from the reformate as a controlling blending component.

Catalytic reforming is used primarily to process the crude cut that contains all the hydrocarbons with 7,8 and 9 carbon atoms in their molecular structure. Lighter materials require higher severities to effect appreciable change, while heavier materials generally lead to more coke formation and deactivation of catalyst.

Despite the fact that reformer feed contains a broad spectrum of individual compounds, some flexibility exists in the choice of operating conditions to adjust severity and run length to optimize yield and octane number for a given feed. The development of bi-metallic catalysts has led to operation at lower pressures, which tends to increase yields and aromatics production. Conversion of the present semi-regenerative units to low pressure cyclic or fully regenerative units would increase the octane barrels produced.

Gasoline pool octane could also be improved by increasing reformer capacity to upgrade the heavy naphthas from catalytic cracking and thermal cracking. Pretreatment of these naphthas to reduce the nitrogen and sulphur to acceptable levels for reforming may be required.

Octane improvement in the gasoline pool can also be realized by diverting low octane components, primarily the normal paraffins, to other products. For example the raffinate from the extraction of the aromatics from a relatively low severity reformate might be used in blending gasoline-type jet fuel instead of straight run heavy naphtha. In some areas there may be a market for these naphthas as feed to steam reformers.

A number of proven processes or combinations of processes are available to improve the octane levels of the lower boiling components.

Once through catalytic isomerization of the C5/C6 light straight run naphtha will increase the RON by about 13 numbers. Separation and recycle to extinction of the normal paraffins will yield 90-91 RON clear. Apart from the improvement in gasoline pool octane this product has an additional advantage. When blended with reformate or alkylate, which are higher boiling materials, it is capable of providing a more uniform octane over the entire boiling range of the finished gasoline.

Other combinations of processes have been proposed aimed at selective use of the propylene-butylene feed stocks currently being processed in alkylation and polymerization units to make higher octane blending stocks.

The 93-94 RON octane rating of the alkylate made from mixed C3/C4 feed is several numbers lower than that made from the B-B cut alone. IFP propose that the propylenes be converted separately to gasoline grade isohexenes with a RON of 97. The product from alkylation of the C4 feed alone would have a RON of 96.

In a similar fashion, in respect of the alkylate product (96 RON) from mixed butylenes the octane number of the alkylate from isobutylene is lower than that produced from the N-butylenes. Isobutylene can be converted to methyl tertiary butyl ether, or MTBE. A combination MTBE-alkylation unit has been suggested to pass the C4 feed through the MTBE process for selective removal of the isobutylene, followed by alkylation of the normal butylene. The MTBE has an octane blending value of 117 and the alkylate from butenes alone is reported to be 99+ RON.

In conclusion a number of processing alternatives do exist to enable the refiner to meet the estimated octane numbers of lead free gasolines. However, in addition to the improvement required in the gasoline pool clear octane, it will probably be necessary to extract and segregate high octane components to provide adequate control during blending.

Therefore, the process scheme best suited to each refinery will require detailed study of the many alternatives available.

TABLE 5-1

BLENDING VALUES OF HIGH OCTANE COMPONENTS

	Research Octane No. (RON)	Motor Octane No. (MON)	Sensitivity (RON + MON)/2
Methanol	112	92	102
Ethanol	110	90	100
MTBE	117	101	109
TBA	109	97	103
Premium Gasoline	96	84	90

Increase in Octane for 5% Addition of High Octane Component Base Octane 92.7/83.7.

	RON	MON
Methanol	0.9	0.29
Ethanol	0.8	0.17
MTBE	1.16	0.84
TBA	0.78	0.63

TABLE 5-2

TYPICAL GASOLINE BASE STOCK OCTANE NUMBERS

Basic Processes	RON	MON	(RON+MON)/2
Light Straight Run	68-73	66-71	67-72
Light FCC Gasoline	94	80	87
FCC Gasoline	92	79	85.5
Lt. Hydrocrackate	80.9	78.7	79.8
Thermally Cracked	77	69	73
Heavy FCC Gasoline	90	78	84
Octane Improvement			
Reformate 100	100	88.4	94.2
Reformate 94	94	83.8	88.9
C4 Alkylate	96	94	95
C3/C4 Alkylate	93	90.8	91.9
C3/C4 Polymer	96.5	82.5	89.5
Selective Processes			
C5	92.3	89.7	91.0
C5/C6 Isomerate (1-Pass)	83.2	81.4	82.3
C5/C6 Isomerate (Total Recycle)	90.7		
Dimersol Isohexenes	97	82	89.5
Toluene	115	97	106
Premium Unleaded (1990)	96.5		
Regular Unleaded (1990)	93.1		

TABLE 5.3

CANADIAN CONVERSION UNIT CAPACITIES - 1983 BPCD (1)

	Catalytic Cracking	Cat. Hydro-Cracking	Thermal Cracking (2)	Catalytic Reforming	Alkylation	Polymerization	C5/C6 Isomerization
Atlantic	47,600	29,700	18,000	46,950	-	4,410	-
Quebec	94,100	27,900	27,500	78,700	4,425	4,030	-
Ontario	138,800	19,200	22,200	137,650	24,500	3,800	-
Western	157,000	-	15,800	91,250	26,900	5,450	-
	437,500	76,800	83,500	354,550	55,825	17,690	-

(1) O & G Journal December 26, 1983

(2) Includes Coking

6.0 CONCLUSIONS

Reducing or eliminating MMT antiknock additive from unleaded motor gasoline and changing grade split, will for most refiners require more severe operation of existing as well as the addition of new octane improvement facilities with attendant costs and energy penalties.

The overall incremental cost to the oil refining Market in 1990 for the two octane levels studied is as follows:-

(1st quarter 1984 Dollars)

	CGSB Octanes	Market Octanes
Capital Cost ($)	235,520,000	379,770,000
Annual Operating Cost ($/YR) (including costs of capital)	87,678,000	140,646,000

As expected, the Market octanes being the higher result in the greatest increase in cost.

The study constraints were maximum use of existing equipment and minimum crude oil consumption. In arriving at the above costs priority was first given to maximum use of existing equipment. If existing equipment could not meet octane requirements and additional equipment was shown to be needed, then the new combination of processes was operated for minimum crude consumption.

It is recognized, therefore, that more definitive evaluation of the individual refineries may show some reduction in capital investment at the expense of increased crude oil requirements and energy penalties.

Since no allowance was made in the simulation for any octane giveaway due to reduced blending flexibility in the absence of MMT additive, these costs, from a study standpoint, may be considered to be the minimum that will be required. To maintain control of blending, the refineries may have to carry larger inventories of the higher octane components, run catalytic reforming at maximum severity or add additional selective processing to separate a blending component of significantly higher octane than those used in the study. All of these carry additional costs and processing penalties over those presented. An overview of processing severity and selectivity is given in Section 5.2.

A complete assessment of all the various possibilities would have to be carried out to determine the optimum solution for any particular location.

The regional breakdown of the incremental capital and operating costs are shown in Table 6-1. No constant pattern of investment emerges, probably because the new investment is entirely for C5/C6 isomerization units and the size of the units in a region are influenced by the volume of isomerization feed in crude as well as the amount of crude run.

The Western region, however, is of particular interest. The area contains 11 refineries made up of several large refineries in the Prairie provinces and a number of smaller refineries on the West Coast and in the interior of British Columbia.

While allowance was made for the higher octane requirements in the B.C. market area, the greater processing capabilities of the larger more modern refineries in the prairies may have overshadowed the real effect that withdrawal of MMT would have on smaller, older refineries in British Columbia. The study showed that Market octane levels could not be met on an MMT free leaded gasolines with existing processing equipment and most refiners will have to add once through isomerization units to maintain quality.

Since capital investment and operating costs per barrel are substantially higher for small units, the economic viability of some of the small refineries may be in jeopardy.

TABLE 6-1

REGIONAL INCREMENTAL CAPITAL AND OPERATING COST SUMMARY

	ATLANTIC	QUEBEC	ONTARIO	WESTERN	TOTAL
CRUDE RUN BPCD	136,400	276,700	447,200	494,600	1,354,900
NO. OF REFINERIES	3	4	5	11	23
AVERAGE BPD	45,500	69,200	89,400	45,000	58,900
CGSB OCTANES					
CAPITAL COST ($000)	40,400	64,410	129,630	1,080	235,520
$/BPD	296	233	290	2	174
ANNUAL OPERATING COST ($000)	16,618	32,342	50,684	(11,965)	87,678
$/BPD	121	117	113	(24)	65
MARKET OCTANES					
CAPITAL COST ($000)	33,490	96,570	93,370	156,340	379,770
$/BPD	245	349	209	316	280
ANNUAL OPERATING COSTS ($000)	10,178	39,622	48,867	41,979	140,646
$/BPD	75	143	109	85	104

7.0 LITERATURE REFERENCES

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8.0 ADDITIONAL STUDY CASES

INTRODUCTION

At the conclusion of the main study four additional cases were studied (using the same methodology as main report) and operating and capital costs identified. The octane specifications, as well as allowable concentration for TEL and MMT additives used for these additional cases, are presented in Table 8-1.

Simulation results, and operating and capital costs for these additional cases are presented separately in this section of the report.

The base case used in the additional cases was that used for establishing incremental operating and capital cost for the main study.

TABLE 8 - 1

SUMMARY OF MOTOR GASOLINE

OCTANE SPECIFICATIONS & ANTIKNOCK ADDITIVE CONCENTRATIONS

	SGSB Octanes		Market Octanes	
	Case 2	Case 3	Case 2	Case 3
Lead Concentration (Leaded Pool) Gms of Pb/L	0.29	0.29	0.29	0.29
MMT Concentration (Unleaded Pool) Mg of Mn/L	0	18	0	18
Gasoline Grade Split (Unleaded/Leaded)	70/30	90/10	70/30	90/10
Octane Specification (R+M/2)Min (Leaded/Unleaded Reg/Unleaded Prem)				
Atlantic	87/87/90	87/87/90	89.8/89/91.8	89.8/89/91.8
Quebec	87/87/90	87/87/90	89.8/89/91.8	89.8/89/91.8
Ontario	87/87/90	87/87/90	89.8/89/91.8	89.8/89/91.8
Western	85/85/88	85/85/88	88.3/88.3/90.8	88.3/88.3/90.8

TABLE 8 - 2

SUMMARY OF RESULTS

ATLANTIC REGION

Case	Reformer Severity	C-5/C-6 Isomerization	Crude Oil Rate BPCD	Crude Rate Increase %	iC-4 Imported	Fuel Gas BPCD (FOE)	Energy Penalty %
Market:							
CASE 2	98	TOTAL (75%)	136360	-.02	0	6169	.017
CASE 3	98	TOTAL (53%)	136338	-.04	0	6136	-.037
CGSB:							
CASE 2	95.5	ONCE THRU (54%)	135803	.19	0	5611	.098
CASE 3	94	NONE	135568	.01	0	5322	.006

TABLE 8 - 3

SUMMARY OF RESULTS

QUEBEC REGION

Case	Reformer Severity	C-5/C-6 Isomerization	Crude Oil Rate BPCD	Crude Rate Increase %	iC-4 Imported	Fuel Gas BPCD (FOE)	Energy Penalty %
Market:							
CASE 2	97.3	TOTAL 70%	278021	.47	0	18953	.125
CASE 3	97	TOTAL 57.5	277281	.21	0	18299	.096
CGSB:							
CASE 2	92	ONCE THRU (44)	276108	.56	0	16732	.156
CASE 3	92	NONE	276175	.58	0	16692	.084

TABLE 8 - 4

SUMMARY OF RESULTS

ONTARIO REGION

Case	Reformer Severity	C-5/C-6 Isomerization	Crude Oil Rate BPCD	Crude Rate Increase %	iC-4 Imported	Fuel Gas BPCD (FOE)	Energy Penalty %
Market:							
CASE 2	98	ONCE THRU 74%	448883	.38	2739	29824	.177
CASE 3	96.5	ONCE THRU 60%	447354	.04	2951	28292	.048
CGSB:							
CASE 2	94.5	ONCE THRU 40%	445538	.24	3222	26265	.186
CASE 3	94	NONE	445085	.14	3338	25740	.036

TABLE 8 - 5

SUMMARY OF RESULTS

WESTERN REGION

Case	Reformer Severity	C-5/C-6 Isomerization	Crude Oil Rate BPCD	Crude Rate Increase %	iC-4 Imported	Fuel Gas BPCD (FOE)	Energy Penalty %
Market:							
CASE 2	99	NONE	496124	.31	1489	27381	.112
CASE 3	96.5	NONE	494746	.03	1523	25149	-.009
CGSB:							
CASE 2	91.8	NONE	491523	.10	1805	20473	.064
CASE 3	90.5	NONE	491214	.03	1798	19636	.018

SIMULATION RESULTS

TABLE 8-6

BASE :-18 mg/l MMT 70/30 Split

REGION:-ATLANTIC - CGSB

CASE-2:-0 mg/l MMT 70/30 Split

PROCESS UNIT	CASE-2 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	135803	135547	256	95	24.32
VACUUM DISTILLATION	61779	61662	117	60	7.02
CATALYTIC CRACKER	44033	43600	433	100	43.3
CATALYTIC POLYMERIZATION	2689	3501	-812	500	-406
HF ALKYLATION	0	0	0	500	0
CATALYTIC REFORMER (SEVERITY)	9650 95.5	9600 94	50	331.25 (CASE) 320 (BASE)	124.563
HYDROTREATER NAPTHA	9650	9600	50	90	4.5
ISOMERISATION	3594 (ONCE THRU)	0	3594	100 (CASE) 100 (BASE)	359.4
HDS-LSR	3594	0	3594	90	323.46
GAS PLANT	14536	14044	492	600	295.2
FUEL GAS (FOE)	5601	5300	301	TOTAL	775.763
HFO PRODUCTION	13901	13901	0		
IMPORTED I-C4	0	0	0		

SIMULATION RESULTS

TABLE 8-7

BASE :-10 mg/l MMT 70/30 Split

REGION:-ATLANTIC - CGSB

CASE-3:-10 mg/l MMT 90/10 Split

PROCESS UNIT	CASE-3 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	135568	135547	21	95	1.995
VACUUM DISTILLATION	61672	61662	10	60	.6
CATALYTIC CRACKER	43685	43680	5	100	.5
CATALYTIC POLYMERIZATION	3508	3501	7	500	3.5
HF ALKYLATION	0	0	0	500	0
CATALYTIC REFORMER (SEVERITY)	9650 94	9600 94	50	320 (CASE) 320 (BASE)	16
HYDROTREATER NAPTHA	9650	9600	50	90	4.5
ISOMERISATION	0	0	0	100 (CASE) 100 (BASE)	0
HDS-LSR	0	0	0	90	0
GAS PLANT	14081	14044	37	600	22.2
FUEL GAS (FOE)	5322	5300	22	TOTAL	49.295
HFO PRODUCTION	13901	13901	0		
IMPORTED I-C4	0	0	0		

SIMULATION RESULTS

TABLE 8-8

BASE :-18 mg/l MMT 70/30 Split

REGION:-ATLANTIC - INDUSTRY

CASE-2:-0 MMT 70/30 Split

PROCESS UNIT	CASE-2 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	276108	274571	1537	95	146.015
VACUUM DISTILLATION	133783	133039	744	60	44.64
CATALYTIC CRACKER	88520	88965	-445	100	-44.5
CATALYTIC POLYMERIZATION	7032	7037	-5	500	-2.5
HF ALKYLATION	2461	2431	30	500	15
CATALYTIC REFORMER (SEVERITY)	32600 92	32600 92	0	305 (CASE) 305 (BASE)	0
HYDROTREATER NAPTHA	32600	32600	0	90	0
ISOMERISATION	8056 (ONCE THRU)	0	8056	100 (CASE) 100 (BASE)	805.6
HDS-LSR	8056	0	8056	90	725.04
GAS PLANT	36021	34632	1389	600	833.4
FUEL GAS (FOE)	16732	15378	1354	TOTAL	2522.70
HFO PRODUCTION	55901	155901	-100000		
IMPORTED I-C4	0	0	0		

SIMULATION RESULTS

TABLE 8-9

BASE :-10 mg/l MMT 70/30 Split

REGION:-QUEBEC - CGSB

CASE-3:-10 mg/l MMT 90/10 Split

PROCESS UNIT	CASE-3 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	276175	274571	1604	95	152.38
VACUUM DISTILLATION	133816	133039	777	60	46.62
CATALYTIC CRACKER	88445	88965	-520	100	-52
CATALYTIC POLYMERIZATION	7434	7037	397	500	198.5
HF ALKYLATION	1636	2431	-795	500	-397.5
CATALYTIC REFORMER (SEVERITY)	33000 92	32600 90	400	305 (CASE) 290 (BASE)	611
HYDROTREATER NAPTHA	33000	32600	400	90	36
ISOMERISATION	0	0	0	100 (CASE) 100 (BASE)	0
HDS-LSR	0	0	0	90	0
GAS PLANT	35893	34632	1261	600	756.6
FUEL GAS (FOE)	16692	15378	1314	TOTAL	1351.6
S/O PRODUCTION	55901	55901	0		
IMPORTED I-C4	0	0	0		

SIMULATION RESULTS

TABLE B-10

BASE :-10 mg/l MMT 70/30 Split

REGION:-ONTARIO - CGSB

CASE-2:-0 mg/l MMT 70/30 Split

PROCESS UNIT	CASE-2 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	445538	444470	1068	95	101.46
VACUUM DISTILLATION	153902	153533	369	60	22.14
CATALYTIC CRACKER	126500	125790	710	100	71
CATALYTIC POLYMERIZATION	0	0	0	500	0
HF ALKYLATION	20737	20736	1	500	.5
CATALYTIC REFORMER (SEVERITY)	61250 94.5	61250 93.3	0	323.75 (CASE) 314.75 (BASE)	551.25
HYDROTREATER NAPTHA	61250	61250	0	90	0
ISOMERISATION	16232 (ONCE THRU)	0	16232	100 (CASE) 100 (BASE)	1623.2
HDS-LSR	16232	0	16232	90	1460.88
GAS PLANT	51780	50311	1469	600	881.4
FUEL GAS (FOE)	26265	24945	1320	TOTAL	4711.83
HFO PRODUCTION	33274	33274	0		
IMPORTED I-C4	3222	3471	-249		

SIMULATION RESULTS

TABLE 8-11

BASE :-10 mg/l MMT 70/30 Split

REGION:-ONTARIO - CGSB

CASE-3:-10 mg/l MMT 90/10 Split

PROCESS UNIT	CASE-3 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	445085	444470	615	95	58.425
VACUUM DISTILLATION	153746	153533	213	60	12.78
CATALYTIC CRACKER	126837	125790	1047	100	104.7
CATALYTIC POLYMERIZATION	0	0	0	500	0
HF ALKYLATION	20738	20736	2	500	1
CATALYTIC REFORMER (SEVERITY)	61000 94	61250 93.3	-250	320 (CASE) 314.75 (BASE)	241.563
HYDROTREATER NAPTHA	61000	61250	-250	90	-22.5
ISOMERISATION	0	0	0	100 (CASE) 100 (BASE)	0
HDS-LSR	0	0	0	90	0
GAS PLANT	51186	50311	875	600	525
FUEL GAS (FOE)	25740	24945	795	TOTAL	920.968
HFO PRODUCTION	33274	33274	0		
IMPORTED I-C4	3338	3471	-133		

SIMULATION RESULTS

TABLE 8-12

BASE :-18 mg/l MMT 70/30 Split

REGION:-WESTERN - CGSB

CASE-2:-0 mg/l MMT 70/30 Split

PROCESS UNIT	CASE-2 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	491523	491056	467	95	44.365
VACUUM DISTILLATION	173482	173317	165	60	9.9
CATALYTIC CRACKER	141145	140639	506	100	50.6
CATALYTIC POLYMERIZATION	6115	6115	0	500	0
HF ALKYLATION	20558	20422	136	500	68
CATALYTIC REFORMER (SEVERITY)	71000 91.0	71000 90	0	303.5 (CASE) 290 (BASE)	958.5
HYDROTREATER NAPTHA	71000	71000	0	90	0
ISOMERISATION	0	0	0	100 (CASE) 100 (BASE)	0
HDS-LSR	0	0	0	90	0
GAS PLANT	59959	58845	1114	600	668.4
FUEL GAS (FOE)	20473	19499	974	TOTAL	1799.77
HFO PRODUCTION	24342	24342	0		
IMPORTED I-C4	1005	1053	-48		

SIMULATION RESULTS

TABLE B-13

BASE :-10 mg/l MMT 70/30 Split

REGION:-WESTERN- CG83

CASE-3:-10 mg/l MMT 90/10 Split

PROCESS UNIT	CASE-3 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)		ADDON ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	491214	491056	158		95	15.01
VACUUM DISTILLATION	173372	173317	55		60	3.3
CATALYTIC CRACKER	140400	140639	-239		100	-23.9
CATALYTIC POLYMERIZATION	6114	6115	-1		500	-.5
HF ALKYLATION	20354	20422	-68		500	-34
CATALYTIC REFORMER (SEVERITY)	71500 90.5	71000 90	500	293.75 (CASE)	290 (BASE)	413.125
HYDROTREATER NAPTHA	71500	71000	500		90	45
ISOMERISATION	0	0	0	100 (CASE)	100 (BASE)	0
HDS-LSR	0	0	0		90	0
GAS PLANT	58972	58845	127		600	76.2
FUEL GAS (FOE)	19636	19499	137		TOTAL	494.235
HFO PRODUCTION	24342	24342	0			
IMPORTED I-C4	1798	1853	-55			

SIMULATION RESULTS

TABLE 8-14

BASE :-10 mg/l MMT 70/30 Split

REGION:-ATLANTIC - MARKET

CASE-2:-0 mg/l MMT 70/30 Split

PROCESS UNIT	CASE-2 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	136360	136386	-26	95	-2.47
VACUUM DISTILLATION	62032	62044	-12	60	-.72
CATALYTIC CRACKER	43865	43870	-5	100	-.5
CATALYTIC POLYMERIZATION	3736	3735	1	500	.5
HF ALKYLATION	0	0	0	500	0
CATALYTIC REFORMER (SEVERITY)	8880 98	8900 98	-20	350 (CASE) 350 (BASE)	-7
HYDROTREATER NAPTHA	8880	8900	-20	90	-1.8
ISOMERISATION	4727 (TOTAL)	6314 (ONCE THRU')	-1587	200 (CASE) 100 (BASE)	314
HDS-LSR	4727	6314	-1587	90	-142.83
GAS PLANT	15292	15329	-37	600	-22.2
FUEL GAS (FOE)	6169	6207	-38	TOTAL	136.98
HFO PRODUCTION	13901	13901	0		
IMPORTED I-C4	0	0	0		

SIMULATION RESULTS

TABLE 8-15

BASE :-10 mg/l MMT 70/30 Split

REGION:-ATLANTIC - MARKET

CASE-3:-10 mg/l MMT 90/10 Split

PROCESS UNIT	CASE-3 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	136338	136386	-48	95	-4.56
VACUUM DISTILLATION	62022	62044	-22	60	-1.32
CATALYTIC CRACKER	43855	43870	-15	100	-1.5
CATALYTIC POLYMERIZATION	3733	3735	-2	500	-1
HF ALKYLATION	0	0	0	500	0
CATALYTIC REFORMER (SEVERITY)	8900 98	8900 98	0	350 (CASE) 350 (BASE)	0
HYDROTREATER NAPTHA	8900	8900	0	90	0
ISOMERISATION	3295 (TOTAL)	6314 (ONCE THRU')	-3019	200 (CASE) 100 (BASE)	27.6
HDS-LSR	3295	6314	-3019	90	-271.71
GAS PLANT	15254	15329	-75	600	-45
FUEL GAS (FOE)	6136	6207	-71	TOTAL	-297.49
HFO PRODUCTION	13901	13901	0		
IMPORTED I-C4	0	0	0		

SIMULATION RESULTS

TABLE 8-16

BASE :-10 mg/l MMT 70/30 Split

REGION:-QUEBEC - MARKET

CASE-2:-0 MMT 70/30 Split

PROCESS UNIT	CASE-2 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	278021	276710	1311	95	124.545
VACUUM DISTILLATION	134710	134075	635	60	38.1
CATALYTIC CRACKER	91181	90720	461	100	46.1
CATALYTIC POLYMERIZATION	7644	7404	240	500	120
HF ALKYLATION	1580	2155	-575	500	-287.5
CATALYTIC REFORMER (SEVERITY)	33000 97.3	32800 96	200	344.75 (CASE) 335 (BASE)	388.75
HYDROTREATER NAPTHA	33000	32800	200	90	18
ISOMERISATION	13027 (TOTAL)	14740 (ONCE THRU')	-1713	200 (CASE) 100 (BASE)	1131.4
HDS-LSR	13027	14740	-1713	90	-154.17
GAS PLANT	38393	37368	1025	600	615
FUEL GAS (FOE)	18953	17792	1161	TOTAL	2040.23
HFO PRODUCTION	55901	55901	0		
IMPORTED I-C4	0	0	0		

SIMULATION RESULTS

TABLE 8-17

BASE :-10 mg/l MMT 70/30 Split

REGION:-QUEBEC - MARKET

CASE-3:-10 mg/l MMT 90/10 Split

PROCESS UNIT	CASE-3 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	277281	276710	571	95	54.245
VACUUM DISTILLATION	134352	134075	277	60	16.62
CATALYTIC CRACKER	90920	90720	200	100	20
CATALYTIC POLYMERIZATION	7484	7404	80	500	40
HF ALKYLATION	2124	2155	-31	500	-15.5
CATALYTIC REFORMER (SEVERITY)	32900 97	32800 96	100	342.5 (CASE) 335 (BASE)	280.25
HYDROTREATER NAPTHA	32900	32800	100	90	9
ISOMERISATION	12390 (TOTAL)	14740 (ONCE THRU')	-2342	200 (CASE) 100 (BASE)	1005.6
HDS-LSR	12398	14740	-2342	90	-210.78
GAS PLANT	37975	37368	607	600	364.2
FUEL GAS (FOE)	18299	17792	507	TOTAL	1563.64
HFO PRODUCTION	55901	55901	0		
IMPORTED I-C4	0	0	0		

SIMULATION RESULTS

TABLE 8-10

BASE :-10 mg/l MMT 70/30 Split

REGION:-ONTARIO - MARKET

CASE-2:-0 mg/l MMT 70/30 Split

PROCESS UNIT	CASE-2 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	448883	447197	1686	95	160.17
VACUUM DISTILLATION	155057	154475	582	60	34.92
CATALYTIC CRACKER	128713	126770	1943	100	194.3
CATALYTIC POLYMERIZATION	0	0	0	500	0
HF ALKYLATION	20810	20807	3	500	1.5
CATALYTIC REFORMER (SEVERITY)	62500 98	62500 96.5	0	350 (CASE) 338.75 (BASE)	703.125
HYDROTREATER NAPTHA	62500	62500	0	90	0
ISOMERISATION	30000 (ONCE THRU)	18212 (ONCE THRU)	11796	100 (CASE) 100 (BASE)	1179.6
HDS-LSR	30000	18212	11796	90	1061.64
GAS PLANT	55715	53752	1963	600	1177.8
FUEL GAS (FOE)	29824	28046	1778	TOTAL	4513.06
HFO PRODUCTION	33274	33274	0		
IMPORTED I-C4	2739	3050	-311		

SIMULATION RESULTS

TABLE B-19

BASE :-10 mg/l MMT 70/30 Split

REGION:-ONTARIO - MARKET

CASE-3:-10 mg/l MMT 90/10 Split

PROCESS UNIT	CASE-3 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)		ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	447354	447197	157		95	14.915
VACUUM DISTILLATION	154529	154475	54		60	3.24
CATALYTIC CRACKER	127825	126770	1055		100	105.5
CATALYTIC POLYMERIZATION	0	0	0		500	0
HF ALKYLATION	20811	20807	4		500	2
CATALYTIC REFORMER (SEVERITY)	62000 96.5	62500 96.5	-500	338.75 (CASE)	338.75 (BASE)	-169.38
HYDROTREATER NAPTHA	62000	62500	-500		90	-45
ISOMERISATION	24167 (ONCE THRU)	18212 (ONCE THRU')	5955	100 (CASE)	100 (BASE)	595.5
HDS-LSR	24167	18212	5955		90	535.95
GAS PLANT	54058	53752	306		600	183.6
FUEL GAS (FOE)	28292	28046	246		TOTAL	1226.33
HFO PRODUCTION	33274	33274	0			
IMPORTED I-C4	2951	3050	-99			

SIMULATION RESULTS

TABLE B-20

BASE :-10 mg/l MMT 70/30 Split

REGION:-WESTERN - MARKET

CASE-2:-0 mg/l MMT 70/30 Split

PROCESS UNIT	CASE-2 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	496124	494602	1522	95	144.59
VACUUM DISTILLATION	175106	174568	538	60	32.28
CATALYTIC CRACKER	149880	143173	6707	100	670.7
CATALYTIC POLYMERIZATION	6123	6116	7	500	3.5
HF ALKYLATION	21428	21102	326	500	163
CATALYTIC REFORMER (SEVERITY)	70750 99	72200 96.5	-1450	357.5 (CASE) 338.75 (BASE)	835.375
HYDROTREATER NAPTHA	70750	72200	-1450	90	-130.5
ISOMERISATION	0	0	0	100 (CASE) 100 (BASE)	0
HDS-LSR	0	0	0	90	0
GAS PLANT	67647	65248	2399	600	1439.4
FUEL GAS (FOE)	27381	25185	2196	TOTAL	3158.35
HFO PRODUCTION	24342	24342	0		
IMPORTED I-C4	1489	1613	-124		

SIMULATION RESULTS

TABLE 8-21

BASE :-10 mg/l MMT 70/30 Split

REGION:-WESTERN - MARKET

CASE-3:-10 mg/l MMT 90/10 Split

PROCESS UNIT	CASE-3 (BPCD)	BASE (BPCD) REQUIRED	INCREMENT (BPCD)	UNIT ENERGY REQUIREMENT (10^3 BTU/BBL)	ADDN ENERGY REQUIREMENT (10^6 BTU/CD)
CRUDE DISTILLATION	494746	494602	144	95	13.68
VACUUM DISTILLATION	174619	174568	51	60	3.06
CATALYTIC CRACKER	142480	143173	-693	100	-69.3
CATALYTIC POLYMERIZATION	6115	6116	-1	500	-.5
HF ALKYLATION	20899	21102	-203	500	-101.5
CATALYTIC REFORMER (SEVERITY)	72200 96.5	72200 96.5	0	338.75 338.75 (CASE) (BASE)	0
HYDROTREATER NAPTHA	72200	72200	0	90	0
ISOMERISATION	0	0	0	100 100 (CASE) (BASE)	0
HDS-LSR	0	0	0	90	0
GAS PLANT	65080	65248	-168	600	-100.8
FUEL GAS (FOE)	25149	25185	-36	TOTAL	-255.36
HFO PRODUCTION	24342	24342	0		
IMPORTED I-C4	1523	1613	-90		

TABLE 8 - 22

SUMMARY OF REQUIRED NEW UNIT CAPACITY

	ISOMERIZATION UNIT					
		BPSD (FOR COST ESIMATION)				
CASE	BPCD FRESH FEED	FRACTIO-NATION	HYDRO-TREATING	REACTOR SEC'T	SIEVE SEC'T	TYPE OF ISOM UNIT
CGSB OCTANES						
ATLANTIC-CASE 2	3388	10824	3566	4280	---	ONCE THRU
ATLANTIC-CASE 3	---	---	---	---	---	--- ---
QUEBEC-CASE 2	8056	25437	8589	10307	---	ONCE THRU
QUEBEC-CASE 3	---	---	---	---	---	--- ---
ONTARIO-CASE 2	16232	51541	17086	20504	---	ONCE THRU
ONTARIO-CASE 3	---	---	---	---	---	--- ---
WESTERN-CASE 2	---	---	---	---	---	--- ---
WESTERN-CASE 3	---	---	---	---	---	--- ---
MARKET OCTANES						
ATLANTIC-CASE 2	4728	14218	4977	5972	5972	TOTAL ISOM
ATLANTIC-CASE 3	3295	9950	3468	4163	4163	TOTAL ISOM
QUEBEC-CASE 2	13027	40810	13713	16455	16455	TOTAL ISOM
QUEBEC-CASE 3	10562	33316	11118	13341	13341	TOTAL ISOM
ONTARIO-CASE 2	30008	96335	31587	37904	---	ONCE THRU
ONTARIO-CASE 3	24243	77621	25519	30623	---	ONCE THRU
WESTERN-CASE 2	---	---	---	---	---	--- ---
WESTERN-CASE 3	---	---	---	---	---	--- ---

TABLE 8 - 23

DETAILED SUMMARY OF REQUIRED NEW UNIT CAPACITIES

CGSB OCTANES - CASE 2

ISOMERIZATION UNIT

Refinery #	Req'd Iso. Capacity	Full Cut Naphtha	Isom. Feed	Hydrotreater	Reactor Section	Sieve Section	Isom. Type
		-FRACTIONATION-					
	BPCD	BPSD	BPSD	BPSD	BPSD	BPSD	
Atlantic							
1	3388	10824	3566	3566	4280	----	ONCE THRU
2	----	----	----	----	----	----	---- ----
3	----	----	----	----	----	----	---- ----
Total (Atlantic)	3388	10824	3566	3566	4280	----	ONCE THRU
Quebec							
1	2691	8394	2834	2834	3401	----	ONCE THRU
2	----	----	----	----	----	----	---- ----
3	5469	17043	5755	5755	6906	----	ONCE THRU
4	----	----	----	----	----	----	---- ----
Total (Quebec)	8160	25437	8589	8589	10307	----	ONCE THRU
Ontario							
1	----	----	----	----	----	----	---- ----
2	----	----	----	----	----	----	---- ----
3	----	----	----	----	----	----	---- ----
4	7954	25255	8372	8372	10047	----	ONCE THRU
5	8278	26286	8714	8714	10457	----	ONCE THRU
Total (Ontario)	16232	51541	17086	17086	20504	----	ONCE THRU
Western							
1	----	----	----	----	----	----	---- ----
2	----	----	----	----	----	----	---- ----
3	----	----	----	----	----	----	---- ----
4	----	----	----	----	----	----	---- ----
5	----	----	----	----	----	----	---- ----
6	----	----	----	----	----	----	---- ----
7	----	----	----	----	----	----	---- ----
8	----	----	----	----	----	----	---- ----
9	----	----	----	----	----	----	---- ----
10	----	----	----	----	----	----	---- ----
11	----	----	----	----	----	----	---- ----
Total (Western)	----	----	----	----	----	----	---- ----

TABLE 8 - 24

DETAILED SUMMARY OF REQUIRED NEW UNIT CAPACITIES

CGSB OCTANES - CASE 3

ISOMERIZATION UNIT

Refinery #	Req'd Iso. Capacity	Full Cut Naphtha	Isom. Feed	Hydrotreater	Reactor Section	Sieve Section	Isom. Type
		-FRACTIONATION-					
	BPCD	BPSD	BPSD	BPSD	BPSD	BPSD	
Atlantic							
1	----	----	----	----	----	----	----
2	----	----	----	----	----	----	----
3	----	----	----	----	----	----	----
Total (Atlantic)	----	----	----	----	----	----	----
Quebec							
1	----	----	----	----	----	----	----
2	----	----	----	----	----	----	----
3	----	----	----	----	----	----	----
4	----	----	----	----	----	----	----
Total (Quebec)	----	----	----	----	----	----	----
Ontario							
1	----	----	----	----	----	----	----
2	----	----	----	----	----	----	----
3	----	----	----	----	----	----	----
4	----	----	----	----	----	----	----
5	----	----	----	----	----	----	----
Total (Ontario)	----	----	----	----	----	----	----
Western							
1	----	----	----	----	----	----	----
2	----	----	----	----	----	----	----
3	----	----	----	----	----	----	----
4	----	----	----	----	----	----	----
5	----	----	----	----	----	----	----
6	----	----	----	----	----	----	----
7	----	----	----	----	----	----	----
8	----	----	----	----	----	----	----
9	----	----	----	----	----	----	----
10	----	----	----	----	----	----	----
11	----	----	----	----	----	----	----
Total (Western)	----	----	----	----	----	----	----

TABLE 8 - 25

DETAILED SUMMARY OF REQUIRED NEW UNIT CAPACITIES

MARKET OCTANES - CASE 2

ISOMERIZATION UNIT

Refinery #	Req'd Iso. Capacity	Full Cut Naphtha	Isom. Feed	Hydrotreater	Reactor Section	Sieve Section	Isom. Type
		-FRACTIONATION-					
	BPCD	BPSD	BPSD	BPSD	BPSD	BPSD	
Atlantic							
1	4350	13081	4579	4579	5494	5494	TOTAL ISOM
2	----	----	----	----	----	----	---- ----
3	378	1137	398	398	478	478	TOTAL ISOM
Total (Atlantic)	4728	14218	4977	4977	5972	5972	TOTAL ISOM
Quebec							
1	2866	8978	3017	3017	3620	3620	TOTAL ISOM
2	4429	13875	4662	4662	5595	5595	TOTAL ISOM
3	5732	17956	6034	6034	7240	7240	TOTAL ISOM
4	----	----	----	----	----	----	----
Total (Quebec)	13027	40810	13713	13713	16455	16455	TOTAL ISOM
Ontario							
1	----	----	----	----	----	----	----
2	7202	23120	7581	7581	9097	----	ONCE THRU
3	6602	21194	6949	6949	8339	----	ONCE THRU
4	7802	25047	8213	8213	9855	----	ONCE THRU
5	8402	26974	8844	8844	10613	----	ONCE THRU
Total (Ontario)	30008	96335	31587	31587	37904	----	ONCE THRU
Western							
1	----	----	----	----	----	----	----
2	----	----	----	----	----	----	----
3	----	----	----	----	----	----	----
4	----	----	----	----	----	----	----
5	----	----	----	----	----	----	----
6	----	----	----	----	----	----	----
7	----	----	----	----	----	----	----
8	----	----	----	----	----	----	----
9	----	----	----	----	----	----	----
10	----	----	----	----	----	----	----
11	----	----	----	----	----	----	----
Total (Western)	----	----	----	----	----	----	----

TABLE 8 - 26

DETAILED SUMMARY OF REQUIRED NEW UNIT CAPACITIES

MARKET OCTANES - CASE 3

ISOMERIZATION UNIT

Refinery #	Req'd Iso. Capacity	Full Cut Naphtha	Isom. Feed	Hydrotreater	Reactor Section	Sieve Section	Isom. Type
		-FRACTIONATION-					
	BPCD	BPSD	BPSD	BPSD	BPSD	BPSD	
Atlantic							
1	3031	9154	3191	3191	3830	3830	TOTAL ISOM
2	----	----	----	----	----	----	----
3	264	796	277	277	333	333	TOTAL ISOM
Total (Atlantic)	3295	9950	3468	3468	4163	4163	TOTAL ISOM
Quebec							
1	----	----	----	----	----	----	----
2	----	----	----	----	----	----	----
3	5703	17991	6004	6004	7204	7204	TOTAL ISOM
4	4859	15325	5114	5114	6137	6137	TOTAL ISOM
Total (Quebec)	10562	33316	11118	11118	13341	13341	TOTAL ISOM
Ontario							
1	11152	35706	11739	11739	14087	----	ONCE THRU
2	6788	21734	7145	7145	8574	----	ONCE THRU
3	6303	20181	6635	6635	7962	----	ONCE THRU
4	----	----	----	----	----	----	----
5	----	----	----	----	----	----	----
Total (Ontario)	24243	77621	25519	25519	30623	----	ONCE THRU
Western							
1	----	----	----	----	----	----	----
2	----	----	----	----	----	----	----
3	----	----	----	----	----	----	----
4	----	----	----	----	----	----	----
5	----	----	----	----	----	----	----
6	----	----	----	----	----	----	----
7	----	----	----	----	----	----	----
8	----	----	----	----	----	----	----
9	----	----	----	----	----	----	----
10	----	----	----	----	----	----	----
11	----	----	----	----	----	----	----
Total (Western)	----	----	----	----	----	----	----

TABLE 8 - 27

SUMMARY OF ESTIMATES

CGSB OCTANES CASE 2

($ MM)

	Isomerization					
	Fractionation	Hydrotreating	Isom Unit	Offsites	Crude Inventory	Total Capital Cost
ATL-BASE	-	-	-	-	-	-
ATL-CASE 2	1.51	3.62	8.89	3.92	0.27	18.21
ATL-DIF$	1.51	3.62	8.89	3.92	0.27	18.21
QUE-BASE	-	-	-	-	-	-
QUE-CASE 2	3.36	8.06	19.96	8.72	1.66	41.76
QUE-DIF$	3.36	8.06	19.96	8.72	1.66	41.76
ONT-BASE	-	-	-	-	-	-
ONT-CASE 2	5.33	12.85	32.50	13.82	1.16	65.66
ONT-DIF$	5.33	12.85	32.50	13.82	1.16	65.66
WES-BASE	-	-	-	-	-	-
WES-CASE 2	-	-	-	-	0.5	0.5
WES-DIF$	-	-	-	-	0.5	0.5
CANADA-BASE	-	-	-	-	-	-
CANADA-CASE 2	10.2	24.53	61.35	26.46	1.78	126.13
CANADA-DIF$	10.2	24.53	61.35	26.46	1.78	126.13

TABLE 8 - 28

SUMMARY OF ESTIMATES

CGSB OCTANES CASE 3

($ MM)

	Isomerization					
	Fractio-nation	Hydro-treating	Isom Unit	Offsites	Crude Inventory	Total Capital Cost
ATL-BASE	-	-	-	-	-	-
ATL-CASE 3	-	-	-	-	0.02	0.02
ATL-DIF$	-	-	-	-	0.02	0.02
QUE-BASE	-	-	-	-	-	-
QUE-CASE 3	-	-	-	-	1.73	1.73
QUE-DIF$	-	-	-	-	1.73	1.73
ONT-BASE	-	-	-	-	-	-
ONT-CASE 3	-	-	-	-	0.67	0.67
ONT-DIF$	-	-	-	-	0.67	0.67
WES-BASE	-	-	-	-	-	-
WES-CASE 3	-	-	-	-	0.17	0.17
WES-DIF$	-	-	-	-	0.17	0.17
CANADA-BASE	-	-	-	-	-	-
CANADA-CASE 3	-	-	-	-	2.59	2.59
CANADA-DIF$	-	-	-	-	2.59	2.59

TABLE 8 - 29

SUMMARY OF ESTIMATES

MARKET OCTANES CASE 2

($ MM)

	Isomerization					
	Fractionation	Hydrotreating	Isom Unit	Offsites	Crude Inventory	Total Capital Cost
ATL-BASE	3.42	8.21	19.56	8.78	-	39.97
ATL-CASE 2	2.52	6.03	33.37	11.80	-0.03	53.69
ATL-DIF$	-0.9	-2.18	13.81	3.02	-0.03	23.72
QUE-BASE	5.77	13.84	34.38	14.93	-	68.92
QUE-CASE 2	5.27	12.65	72.92	25.36	1.41	117.61
QUE-DIF$	-0.50	-1.19	38.54	10.43	1.41	48.69
ONT-BASE	5.7	13.78	35.25	14.71	-	69.44
ONT-CASE 2	7.39	17.79	44.83	19.17	1.84	91.02
ONT-DIF$	1.69	4.01	9.58	4.46	1.84	21.58
WES-BASE	-	-	-	-	-	-
WES-CASE 2	-	-	-	-	1.62	1.62
WES-DIF$	-	-	-	-	1.62	1.62
CANADA-BASE	14.89	35.83	89.19	38.42	-	178.33
CANADA-CASE 2	15.18	36.47	151.09	56.33	3.31	263.91
CANADA-DIF$	0.29	0.64	71.90	17.91	3.31	85.58

TABLE 8 - 30

SUMMARY OF ESTIMATES

MARKET OCTANES CASE 3

($ MM)

	Isomerization					
	Fractionation	Hydrotreating	Isom Unit	Offsites	Crude Inventory	Total Capital Cost
ATL-BASE	3.42	8.21	19.56	8.78	-	39.97
ATL-CASE 3	2.15	5.13	28.02	10.02	0.05	45.37
ATL-DIF$	-1.27	-3.08	8.46	1.24	0.05	15.40
QUE-BASE	5.77	13.84	34.38	14.93	-	68.92
QUE-CASE 3	4.03	9.68	55.94	19.35	0.62	89.62
QUE-DIF$	-1.74	-4.16	21.56	4.42	0.62	20.07
ONT-BASE	5.7	13.78	35.25	14.71	-	69.44
ONT-CASE 3	7.9	19.07	48.27	20.51	0.17	95.92
ONT-DIF$	2.2	5.29	13.02	5.8	0.17	26.48
WES-BASE	-	-	-	-	-	-
WES-CASE 3	-	-	-	-	0.15	0.15
WES-DIF$	-	-	-	-	0.15	0.15
CANADA-BASE	14.89	35.83	89.19	38.42	-	178.33
CANADA-CASE 3	14.08	33.88	132.23	49.88	0.84	231.06
CANADA-DIF$	-0.81	-1.95	43.04	11.46	0.84	52.73

TABLE 8 - 31

SUMMARY OF INVESTMENT COSTS

($ MM)

REGION: CANADA

REGION	CGSB OCTANES CASE 2	CGSB OCTANES CASE 3	MARKET OCTANES CASE 2	MARKET OCTANES CASE 3
ATLANTIC	18.21	0.02	53.69	45.37
QUEBEC	41.76	1.73	117.61	89.62
ONTARIO	65.66	0.67	91.02	95.92
WESTERN	0.50	0.17	1.62	0.15
TOTAL CANADA	126.13	2.59	263.94	231.06

TABLE 8 - 32

ESTIMATE DETAIL

($ MM)

REGION: Atlantic

Refinery #1

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	1.51	-	1.78	1.40
1.2 Hydrotreater	3.55	-	4.17	3.30
--Catalyst	0.07	-	0.09	0.06
1.3 Once Thru Isom.(reactor sect.)	8.00	-	-	-
--Catalyst	0.89	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	22.51	17.80
--Catalyst	-	-	2.02	1.41
Total Onsite Capital Cost:	14.01	-	30.57	23.98
2. Total Offsite Capital Cost (30%)	3.92	-	8.54	6.75
TOTAL INVESTMENT	17.93	-	39.10	30.73

TABLE 8 - 33

ESTIMATE DETAIL

($ MM)

REGION: Atlantic — **Refinery #2**

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	-	-
1.2 Hydrotreater	-	-	-	-
--Catalyst	-	-	-	-
1.3 Once Thru Isom.(reactor sect.)	-	-	-	-
--Catalyst	-	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	-
2. Total Offsite Capital Cost (30%)	-	-	-	-
TOTAL INVESTMENT	-	-	-	-

TABLE 8 - 34

ESTIMATE DETAIL

($ MM)

REGION: Atlantic

Refinery #3

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	0.74	0.74
1.2 Hydrotreater	-	-	1.75	1.75
--Catalyst	-	-	0.02	0.02
1.3 Once Thru Isom.(reactor sect.)	-	-	-	-
--Catalyst	-	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	8.37	8.37
--Catalyst	-	-	0.44	0.44
Total Onsite Capital Cost:	-	-	11.33	11.33
2. Total Offsite Capital Cost (30%)	-	-	3.26	3.26
TOTAL INVESTMENT	-	-	14.59	14.59

TABLE 8 - 35

ESTIMATE DETAIL

($ MM)

REGION: Quebec

Refinery #1

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	1.30	-	1.35	-
1.2 Hydrotreater	3.06	-	3.18	-
--Catalyst	0.05	-	0.06	-
1.3 Once Thru Isom.(reactor sect.)	6.89	-	-	-
--Catalyst	0.71	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	17.16	-
--Catalyst	-	-	1.39	-
Total Onsite Capital Cost:	12.01	-	23.09	-
2. Total Offsite Capital Cost (30%)	3.37	-	6.51	-
TOTAL INVESTMENT	15.38	-	29.60	-

TABLE 8 - 36

ESTIMATE DETAIL

($ MM)

REGION: Quebec

Refinery #2

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	1.80	-
1.2 Hydrotreater	-	-	4.22	-
--Catalyst	-	-	0.09	-
1.3 Once Thru Isom.(reactor sect.)	-	-	-	-
--Catalyst	-	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	22.78	-
--Catalyst	-	-	2.06	-
Total Onsite Capital Cost:	-	-	30.94	-
2. Total Offsite Capital Cost (30%)	-	-	8.64	-
TOTAL INVESTMENT	-	-	39.58	-

TABLE 8 - 37

ESTIMATE DETAIL

($ MM)

REGION: Quebec

Refinery #3

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	2.06	-	2.12	2.12
1.2 Hydrotreater	4.84	-	4.99	4.98
--Catalyst	0.11	-	0.11	0.11
1.3 Once Thru Isom.(reactor sect.)	10.92	-	-	-
--Catalyst	1.44	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	26.93	26.84
--Catalyst	-	-	2.66	2.65
Total Onsite Capital Cost:	19.37	-	36.83	36.70
2. Total Offsite Capital Cost (30%)	5.35	-	10.21	10.18
TOTAL INVESTMENT	24.71	-	47.04	46.88

TABLE 8 - 38

ESTIMATE DETAIL

($ MM)

REGION: Quebec

Refinery #4

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	-	1.91
1.2 Hydrotreater	-	-	-	4.49
--Catalyst	-	-	-	0.10
1.3 Once Thru Isom.(reactor sect.)	-	-	-	-
--Catalyst	-	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	-	24.19
--Catalyst	-	-	-	2.26
Total Onsite Capital Cost:	-	-	-	32.93
2. Total Offsite Capital Cost (30%)	-	-	-	9.17
TOTAL INVESTMENT	-	-	-	42.11

TABLE 8 - 39

ESTIMATE DETAIL

($ MM)

REGION: Ontario

Refinery #1

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	-	3.27
1.2 Hydrotreater	-	-	-	7.70
--Catalyst	-	-	-	0.22
1.3 Once Thru Isom.(reactor sect.)	-	-	-	17.35
--Catalyst	-	-	-	2.93
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	31.48
2. Total Offsite Capital Cost (30%)	-	-	-	8.50
TOTAL INVESTMENT	-	-	-	39.97

TABLE 8 - 40

ESTIMATE DETAIL

($ MM)

REGION: Ontario   Refinery #2

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	2.46	2.37
1.2 Hydrotreater	-	-	5.79	5.57
--Catalyst	-	-	0.14	0.14
1.3 Once Thru Isom.(reactor sect.)	-	-	13.06	12.57
--Catalyst	-	-	1.89	1.78
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	23.35	22.43
2. Total Offsite Capital Cost (30%)	-	-	6.39	6.15
TOTAL INVESTMENT	-	-	29.75	28.58

TABLE 8 - 41

ESTIMATE DETAIL

($ MM)

REGION: Ontario

Refinery #3

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	2.33	2.26
1.2 Hydrotreater	-	-	5.47	5.31
--Catalyst	-	-	0.13	0.13
1.3 Once Thru Isom.(reactor sect.)	-	-	12.34	11.98
--Catalyst	-	-	1.73	1.66
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	22.01	21.33
2. Total Offsite Capital Cost (30%)	-	-	6.04	5.86
TOTAL INVESTMENT	-	-	28.05	27.19

TABLE 8 - 42

ESTIMATE DETAIL

($ MM)

REGION: Ontario

Refinery #4

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	2.63	-	2.60	-
1.2 Hydrotreater	6.18	-	6.10	-
--Catalyst	0.16	-	0.16	-
1.3 Once Thru Isom.(reactor sect.)	13.93	-	13.76	-
--Catalyst	2.09	-	2.05	-
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	24.99	-	24.66	-
2. Total Offsite Capital Cost (30%)	6.82	-	6.74	-
TOTAL INVESTMENT	31.81	-	31.40	-

TABLE 8 - 43

ESTIMATE DETAIL

($ MM)

REGION: Ontario | **Refinery #5**

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	2.70	-	2.72	-
1.2 Hydrotreater	6.34	-	6.40	-
--Catalyst	0.17	-	0.17	-
1.3 Once Thru Isom.(reactor sect.)	14.30	-	14.43	-
--Catalyst	2.18	-	2.21	-
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	25.68	-	25.94	-
2. Total Offsite Capital Cost (30%)	7.00	-	7.07	-
TOTAL INVESTMENT	32.68	-	33.01	-

TABLE 8 - 44

ESTIMATE DETAIL

($ MM)

REGION: Western

Refinery #1

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	-	-
1.2 Hydrotreater	-	-	-	-
--Catalyst	-	-	-	-
1.3 Once Thru Isom.(reactor sect.)	-	-	-	-
--Catalyst	-	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	-
2. Total Offsite Capital Cost (30%)	-	-	-	-
TOTAL INVESTMENT	-	-	-	-

TABLE 8 - 45

ESTIMATE DETAIL

($ MM)

REGION: Western | **Refinery #2**

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	-	-
1.2 Hydrotreater	-	-	-	-
--Catalyst	-	-	-	-
1.3 Once Thru Isom.(reactor sect.)	-	-	-	-
--Catalyst	-	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	-
2. Total Offsite Capital Cost (30%)	-	-	-	-
TOTAL INVESTMENT	-	-	-	-

TABLE 8 - 46

ESTIMATE DETAIL

($ MM)

REGION: Western

Refinery #3

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	-	-
1.2 Hydrotreater	-	-	-	-
--Catalyst	-	-	-	-
1.3 Once Thru Isom.(reactor sect.)	-	-	-	-
--Catalyst	-	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	-
2. Total Offsite Capital Cost (30%)	-	-	-	-
TOTAL INVESTMENT	-	-	-	-

TABLE 8 - 47

ESTIMATE DETAIL

($ MM)

REGION: Western

Refinery #4

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	-	-
1.2 Hydrotreater	-	-	-	-
--Catalyst	-	-	-	-
1.3 Once Thru Isom.(reactor sect.)	-	-	-	-
--Catalyst	-	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	-
2. Total Offsite Capital Cost (30%)	-	-	-	-
TOTAL INVESTMENT	-	-	-	-

TABLE 8 - 48

ESTIMATE DETAIL

($ MM)

REGION: Western

Refinery #5

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	-	-
1.2 Hydrotreater	-	-	-	-
--Catalyst	-	-	-	-
1.3 Once Thru Isom.(reactor sect.)	-	-	-	-
--Catalyst	-	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	-
2. Total Offsite Capital Cost (30%)	-	-	-	-
TOTAL INVESTMENT	-	-	-	-

TABLE 8 - 49

ESTIMATE DETAIL

($ MM)

REGION: Western **Refinery #6**

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	-	-
1.2 Hydrotreater	-	-	-	-
--Catalyst	-	-	-	-
1.3 Once Thru Isom.(reactor sect.)	-	-	-	-
--Catalyst	-	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	-
2. Total Offsite Capital Cost (30%)	-	-	-	-
TOTAL INVESTMENT	-	-	-	-

TABLE 8 - 50

ESTIMATE DETAIL

($ MM)

REGION: Western

Refinery #7

		CGSB Octanes		Market Octanes	
		CASE 2	CASE 3	CASE 2	CASE 3
1.	Isomerization				
1.1	Fractionation	-	-	-	-
1.2	Hydrotreater	-	-	-	-
	--Catalyst	-	-	-	-
1.3	Once Thru Isom.(reactor sect.)	-	-	-	-
	--Catalyst	-	-	-	-
1.4	Total Isom. (reactor&sieve sect.	-	-	-	-
	--Catalyst	-	-	-	-
	Total Onsite Capital Cost:	-	-	-	-
2.	Total Offsite Capital Cost (30%)	-	-	-	-
	TOTAL INVESTMENT	-	-	-	-

TABLE 8 - 51

ESTIMATE DETAIL

($ MM)

REGION: Western **Refinery #8**

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	-	-
1.2 Hydrotreater	-	-	-	-
--Catalyst	-	-	-	-
1.3 Once Thru Isom.(reactor sect.)	-	-	-	-
--Catalyst	-	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	-
2. Total Offsite Capital Cost (30%)	-	-	-	-
TOTAL INVESTMENT	-	-	-	-

TABLE 8 - 52

ESTIMATE DETAIL

($ MM)

REGION: Western

Refinery #9

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	-	-
1.2 Hydrotreater	-	-	-	-
--Catalyst	-	-	-	-
1.3 Once Thru Isom.(reactor sect.)	-	-	-	-
--Catalyst	-	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	-
2. Total Offsite Capital Cost (30%)	-	-	-	-
TOTAL INVESTMENT	-	-	-	-

TABLE 8 - 53

ESTIMATE DETAIL

($ MM)

REGION: Western **Refinery #10**

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	-	-
1.2 Hydrotreater	-	-	-	-
--Catalyst	-	-	-	-
1.3 Once Thru Isom.(reactor sect.)	-	-	-	-
--Catalyst	-	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	-
2. Total Offsite Capital Cost (30%)	-	-	-	-
TOTAL INVESTMENT	-	-	-	-

TABLE 8 - 54

ESTIMATE DETAIL

($ MM)

REGION: Western **Refinery #11**

	CGSB Octanes		Market Octanes	
	CASE 2	CASE 3	CASE 2	CASE 3
1. Isomerization				
1.1 Fractionation	-	-	-	-
1.2 Hydrotreater	-	-	-	-
--Catalyst	-	-	-	-
1.3 Once Thru Isom. (reactor sect.)	-	-	-	-
--Catalyst	-	-	-	-
1.4 Total Isom. (reactor&sieve sect.	-	-	-	-
--Catalyst	-	-	-	-
Total Onsite Capital Cost:	-	-	-	-
2. Total Offsite Capital Cost (30%)	-	-	-	-
TOTAL INVESTMENT	-	-	-	-

TABLE 8 - 55

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: ATLANTIC

BASE: CGSB OCTANES (18mg/L Mn 70/30 SPLIT)

CASE 2: CGSB OCTANES (0 MMT 70/30 SPLIT)

1. POWER COST	561
2. FUEL & STEAM COSTS	-5030
3. COST OF ADDITIONAL CRUDE	9070
4. COST OF IMPORTED i-C4	---
5. CREDIT FOR EXTRA HFO PROD'N	---
6. CATALYSTS REPLACEMENTS COSTS*	1700
7. WAGES*	880
8. CREDIT FOR LEAD ADDITIVES	---
9. CREDIT FOR MMT	-5354
TOTAL $/CD	1827
TOTAL $MM/YR	0.67

* BASED ON THE FOLLOWING

1 ISOMERIZATION UNITS (ONCE THRU) ADDITIONAL TO BASE CASE

TABLE 8 - 56

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: QUEBEC

BASE: CGSB OCTANES (18mg/L Mn 70/30 SPLIT)

CASE 2: CGSB OCTANES (0 MMT 70/30 SPLIT)

1. POWER COST	653
2. FUEL & STEAM COSTS	-26438
3. COST OF ADDITIONAL CRUDE	55286
4. COST OF IMPORTED i-C4	---
5. CREDIT FOR EXTRA HFO PROD'N	---
6. CATALYSTS REPLACEMENTS COSTS*	4200
7. WAGES*	1760
8. CREDIT FOR LEAD ADDITIVES	---
9. CREDIT FOR MMT	-11251
TOTAL $/CD	24210
TOTAL $MM/YR	8.84

* BASED ON THE FOLLOWING

2 ISOMERIZATION UNITS (ONCE THRU) ADDITIONAL TO BASE CASE

TABLE 8 - 57

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: ONTARIO

BASE: CGSB OCTANES (18mg/L Mn 70/30 SPLIT)

CASE 2: CGSB OCTANES (0 MMT 70/30 SPLIT)

1.	POWER COST	1560
2.	FUEL & STEAM COSTS	-17650
3.	COST OF ADDITIONAL CRUDE	38747
4.	COST OF IMPORTED i-C4	-7522
5.	CREDIT FOR EXTRA HFO PROD'N	---
6.	CATALYSTS REPLACEMENTS COSTS*	8300
7.	WAGES*	1760
8.	CREDIT FOR LEAD ADDITIVES	---
9.	CREDIT FOR MMT	-21765
	TOTAL $/CD	3430
	TOTAL $MM/YR	1.25

* BASED ON THE FOLLOWING

2 ISOMERIZATION UNITS (ONCE THRU) ADDITIONAL TO BASE CASE

TABLE 8 - 58

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: WESTERN

BASE: CGSB OCTANES (18mg/L Mn 70/30 SPLIT)

CASE 2: CGSB OCTANES (0 MMT 70/30 SPLIT)

1.	POWER COST	142
2.	FUEL & STEAM COSTS	-17686
3.	COST OF ADDITIONAL CRUDE	16593
4.	COST OF IMPORTED i-C4	-1374
5.	CREDIT FOR EXTRA HFO PROD'N	---
6.	CATALYSTS REPLACEMENTS COSTS*	---
7.	WAGES*	---
8.	CREDIT FOR LEAD ADDITIVES	---
9.	CREDIT FOR MMT	-25602
	TOTAL $/CD	-27927
	TOTAL $MM/YR	-10.19

* BASED ON THE FOLLOWING

0 ISOMERIZATION UNITS (--) ADDITIONAL TO BASE CASE

TABLE 8 - 59

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: ATLANTIC

BASE: CGSB OCTANES (18mg/L Mn 70/30 SPLIT)

CASE 3: CGSB OCTANES (18mg/L 90/10 SPLIT)

1. POWER COST	1.7
2. FUEL & STEAM COSTS	-387
3. COST OF ADDITIONAL CRUDE	744
4. COST OF IMPORTED i-C4	---
5. CREDIT FOR EXTRA HFO PROD'N	---
6. CATALYSTS REPLACEMENTS COSTS*	---
7. WAGES*	---
8. CREDIT FOR LEAD ADDITIVES	-1709
9. CREDIT FOR MMT	1528
TOTAL $/CD	193
TOTAL $MM/YR	0.07

* BASED ON THE FOLLOWING

0 ISOMERIZATION UNITS (--) ADDITIONAL TO BASE CASE

TABLE 8 - 60

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: QUEBEC
BASE: CGSB OCTANES (18mg/L Mn 70/30 SPLIT)
CASE 3: CGSB OCTANES (18mg/L Mn 90/10 SPLIT)

1.	POWER COST	32
2.	FUEL & STEAM COSTS	-29640
3.	COST OF ADDITIONAL CRUDE	57696
4.	COST OF IMPORTED i-C4	---
5.	CREDIT FOR EXTRA HFO PROD'N	---
6.	CATALYSTS REPLACEMENTS COSTS*	---
7.	WAGES*	---
8.	CREDIT FOR LEAD ADDITIVES	-3594
9.	CREDIT FOR MMT	3215
	TOTAL $/CD	27709
	TOTAL $MM/YR	10.11

* BASED ON THE FOLLOWING

0 ISOMERIZATION UNITS (--) ADDITIONAL TO BASE CASE

TABLE 8 - 61

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: ONTARIO

BASE: CGSB OCTANES (18mg/L Mn 70/30 SPLIT)

CASE 3: CGSB OCTANES (18mg/L 90/10 SPLIT)

1. POWER COST	218
2. FUEL & STEAM COSTS	-18258
3. COST OF ADDITIONAL CRUDE	22312
4. COST OF IMPORTED i-C4	-4018
5. CREDIT FOR EXTRA HFO PROD'N	---
6. CATALYSTS REPLACEMENTS COSTS*	---
7. WAGES*	---
8. CREDIT FOR LEAD ADDITIVES	-6953
9. CREDIT FOR MMT	6219
TOTAL $/CD	-419
TOTAL $MM/YR	-0.18

* BASED ON THE FOLLOWING

0 ISOMERIZATION UNITS (--) ADDITIONAL TO BASE CASE

TABLE 8 - 62

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: WESTERN

BASE: CGSB OCTANES (18mg/L Mn 70/30 SPLIT)

CASE 3: CGSB OCTANES (18mg/L Mn 90/10 SPLIT)

1.	POWER COST	21
2.	FUEL & STEAM COSTS	1530
3.	COST OF ADDITIONAL CRUDE	5614
4.	COST OF IMPORTED i-C4	-1574
5.	CREDIT FOR EXTRA HFO PROD'N	---
6.	CATALYSTS REPLACEMENTS COSTS*	---
7.	WAGES*	---
8.	CREDIT FOR LEAD ADDITIVES	-8179
9.	CREDIT FOR MMT	7315
	TOTAL $/CD	4727
	TOTAL $MM/YR	1.7

* BASED ON THE FOLLOWING

0 ISOMERIZATION UNITS (--) ADDITIONAL TO BASE CASE

TABLE 8 - 63

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: ATLANTIC

BASE: MARKET OCTANES (18mg/L Mn 70/30 SPLIT)

CASE 2: MARKET OCTANES (0 MMT 70/30 SPLIT)

1.	POWER COST	102
2.	FUEL & STEAM COSTS	1592
3.	COST OF ADDITIONAL CRUDE	-921
4.	COST OF IMPORTED i-C4	---
5.	CREDIT FOR EXTRA HFO PROD'N	---
6.	CATALYSTS REPLACEMENTS COSTS*	4600
7.	WAGES*	880
8.	CREDIT FOR LEAD ADDITIVES	---
9.	CREDIT FOR MMT	-11251
	TOTAL $/CD	-4998
	TOTAL $MM/YR	-1.8

* BASED ON THE FOLLOWING

2 ISOMERIZATION UNITS (SIEVE SECT) ADDITIONAL TO BASE CASE
1 ISOMERIZATION UNIT (ONCE THRU) LESS THAN BASE CASE

TABLE 8 - 64

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: QUEBEC

BASE: MARKET OCTANES (18mg/L Mn 70/30 SPLIT)

CASE 2: MARKET OCTANES (0 MMT 70/30 SPLIT)

1.	POWER COST	525
2.	FUEL & STEAM COSTS	-22945
3.	COST OF ADDITIONAL CRUDE	47157
4.	COST OF IMPORTED i-C4	---
5.	CREDIT FOR EXTRA HFO PROD'N	---
6.	CATALYSTS REPLACEMENTS COSTS*	11300
7.	WAGES*	2640
8.	CREDIT FOR LEAD ADDITIVES	---
9.	CREDIT FOR MMT	-11251
	TOTAL $/CD	27426
	TOTAL $MM/YR	10.0

* BASED ON THE FOLLOWING

3 ISOMERIZATION UNITS (SIEVE SECT) ADDITIONAL TO BASE CASE

TABLE 8 - 65

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: ONTARIO

BASE: MARKET OCTANES (18mg/L Mn 70/30 SPLIT)

CASE 2: MARKET OCTANES (0 MMT 70/30 SPLIT)

1.	POWER COST	1454
2.	FUEL & STEAM COSTS	-31167
3.	COST OF ADDITIONAL CRUDE	61168
4.	COST OF IMPORTED i-C4	-9395
5.	CREDIT FOR EXTRA HFO PROD'N	---
6.	CATALYSTS REPLACEMENTS COSTS*	15400
7.	WAGES*	1760
8.	CREDIT FOR LEAD ADDITIVES	---
9.	CREDIT FOR MMT	-21765
	TOTAL $/CD	17455
	TOTAL $MM/YR	6.4

* BASED ON THE FOLLOWING

2 ISOMERIZATION UNITS (ONCE THRU) ADDITIONAL TO BASE CASE

TABLE 8 - 66

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: WESTERN

BASE: MARKET OCTANES (18mg/L Mn 70/30 SPLIT)

CASE 2: MARKET OCTANES (0 MMT 70/30 SPLIT)

1.	POWER COST	904
2.	FUEL & STEAM COSTS	-44527
3.	COST OF ADDITIONAL CRUDE	54077
4.	COST OF IMPORTED i-C4	-3549
5.	CREDIT FOR EXTRA HFO PROD'N	---
6.	CATALYSTS REPLACEMENTS COSTS*	---
7.	WAGES*	---
8.	CREDIT FOR LEAD ADDITIVES	---
9.	CREDIT FOR MMT	-25602
	TOTAL $/CD	-18697
	TOTAL $MM/YR	-6.82

* BASED ON THE FOLLOWING

0 ISOMERIZATION UNITS (--) ADDITIONAL TO BASE CASE

TABLE 8 - 67

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: ATLANTIC

BASE: MARKET OCTANES (18mg/L Mn 70/30 SPLIT)

CASE 3: MARKET OCTANES (18mg/L Mn 90/10 SPLIT)

1.	POWER COST	-187
2.	FUEL & STEAM COSTS	812
3.	COST OF ADDITIONAL CRUDE	-1701
4.	COST OF IMPORTED i-C4	---
5.	CREDIT FOR EXTRA HFO PROD'N	---
6.	CATALYSTS REPLACEMENTS COSTS*	3500
7.	WAGES*	880
8.	CREDIT FOR LEAD ADDITIVES	-1709
9.	CREDIT FOR MMT	1397
	TOTAL $/CD	2992
	TOTAL $MM/YR	1.1

* BASED ON THE FOLLOWING

2 ISOMERIZATION UNITS (SIEVE SECT) ADDITIONAL TO BASE CASE
1 ISOMERIZATION UNITS (ONCE THRU) LESS THAN BASE CASE

TABLE 8 - 68

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: QUEBEC

BASE: MARKET OCTANES (18mg/L Mn 70/30 SPLIT)

CASE 3: MARKET OCTANES (18mg/L Mn 90/10 SPLIT)

1. POWER COST	399
2. FUEL & STEAM COSTS	-7236
3. COST OF ADDITIONAL CRUDE	20539
4. COST OF IMPORTED i-C4	---
5. CREDIT FOR EXTRA HFO PROD'N	---
6. CATALYSTS REPLACEMENTS COSTS*	9300
7. WAGES*	880
8. CREDIT FOR LEAD ADDITIVES	-3594
9. CREDIT FOR MMT	3215
TOTAL $/CD	23503
TOTAL $MM/YR	8.58

* BASED ON THE FOLLOWING

2 ISOMERIZATION UNITS (SIEVE SECT) ADDITIONAL TO BASE CASE
1 ISOMERIZATION UNIT (ONCE THRU) LESS THAN BASE CASE

TABLE 8 - 69

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: ONTARIO
BASE: MARKET OCTANES (18mg/L Mn 70/30 SPLIT)
CASE 3: MARKET OCTANES (18mg/L Mn 90/10 SPLIT)

1. POWER COST	624
2. FUEL & STEAM COSTS	-2167
3. COST OF ADDITIONAL CRUDE	5696
4. COST OF IMPORTED i-C4	-2991
5. CREDIT FOR EXTRA HFO PROD'N	---
6. CATALYSTS REPLACEMENTS COSTS*	12400
7. WAGES*	880
8. CREDIT FOR LEAD ADDITIVES	-6953
9. CREDIT FOR MMT	6219
TOTAL $/CD	13708
TOTAL $MM/YR	5.0

* BASED ON THE FOLLOWING

1 ISOMERIZATION UNITS (ONCE THRU) ADDITIONAL TO BASE CASE

TABLE 8 - 70

SUMMARY OF INCREMENTAL PROCESS OPERATING COSTS

REGION: WESTERN

BASE: MARKET OCTANES (18mg/L Mn 70/30 SPLIT)

CASE 3: MARKET OCTANES (18mg/L Mn 90/10 SPLIT)

1. POWER COST	-112
2. FUEL & STEAM COSTS	100
3. COST OF ADDITIONAL CRUDE	5116
4. COST OF IMPORTED i-C4	-2576
5. CREDIT FOR EXTRA HFO PROD'N	---
6. CATALYSTS REPLACEMENTS COSTS*	---
7. WAGES*	---
8. CREDIT FOR LEAD ADDITIVES	-8179
9. CREDIT FOR MMT	7315
TOTAL $/CD	1664
TOTAL $MM/YR	0.61

* BASED ON THE FOLLOWING

0 ISOMERIZATION UNITS (--) ADDITIONAL TO BASE CASE

TABLE 8-71

ANNUAL OPERATING COST

REGION: ATLANTIC

	CGSB Octanes		Market Octanes	
	Case2	Case3	Case2	Case3
CAPITAL EQUIPMENT COST - $ MM/YR				
Isomerization Units	14.02	-	41.92	35.30
Offsites	3.92	-	11.80	10.02
Crude Inventory	0.27	0.02	-0.03	0.05
Total	18.21	0.02	53.69	45.37

ANNUAL OPERATING COST $ MM/YR

	CGSB Octanes		Market Octanes	
	Case2	Case3	Case2	Case3
Capital Charges (25%)	4.55	-	13.42	11.34
Insurance (0.5%)	0.09	-	0.27	0.23
Local Taxes (1.0%)	0.18	-	0.54	0.45
Maintenance (5.5%	1.00	-	2.95	2.49
Process Operating Cost (Incremental Total)	0.67	0.07	-1.80	1.10
Total	6.49	0.07	15.38	15.61
Incremental Annual Operating Cost (Case1 - BASE)	6.49	0.07	2.592	2.822

TABLE 8 - 72

ANNUAL OPERATING COST

REGION: QUEBEC

CAPITAL EQUIPMENT COST - $ MM/YR	CGSB Octanes		Market Octanes	
	Case2	Case3	Case2	Case3
Isomerization Units	31.38	-	90.84	69.65
Offsites	8.72	-	25.26	19.35
Crude Inventory	1.66	1.73	1.41	0.62
Total	41.76	1.73	117.61	89.62

ANNUAL OPERATING COST $ MM/YR

	CGSB Octanes		Market Octanes	
	Case2	Case3	Case2	Case3
Capital Charges (25%)	10.44	0.43	29.40	22.40
Insurance (0.5%)	0.20	-	0.59	0.45
Local Taxes (1.0%)	0.40	-	1.18	0.90
Maintenance (5.5%	2.22	-	6.47	4.93
Process Operating Cost (Incremental Total)	8.84	10.11	10.00	8.58
Total	22.10	10.54	47.64	37.26
Incremental Annual Operating Cost (Case1 - BASE)	22.10	10.54	25.585	15.205

TABLE 8 - 73

ANNUAL OPERATING COST

REGION: ONTARIO

CAPITAL EQUIPMENT COST - $ MM/YR	CGSB Octanes		Market Octanes	
	Case2	Case3	Case2	Case3
Isomerization Units	50.68	-	70.01	75.24
Offsites	13.82	-	19.17	20.51
Crude Inventory	1.16	0.67	1.84	0.17
Total	65.66	0.67	91.02	95.92

ANNUAL OPERATING COST $ MM/YR

	CGSB Octanes		Market Octanes	
	Case2	Case3	Case2	Case3
Capital Charges (25%)	16.42	0.17	22.76	23.98
Insurance (0.5%)	0.33	-	0.46	0.48
Local Taxes (1.0%)	0.66	-	0.91	0.96
Maintenance (5.5%	3.61	-	5.00	5.28
Process Operating Cost (Incremental Total)	1.25	-0.18	6.4	5.00
Total	22.27	-0.01	35.53	35.70
Incremental Annual Operating Cost (Case1 - BASE)	22.27	-0.01	13.31	13.48

TABLE 8 - 74

ANNUAL OPERATING COST

REGION: WESTERN

	CGSB Octanes		Market Octanes	
	Case2	Case3	Case2	Case3
CAPITAL EQUIPMENT COST - $ MM/YR				
Isomerization Units	-	-	-	-
Offsites	-	-	-	-
Crude Inventory	0.5	0.17	1.62	0.15
Total	0.5	0.17	1.62	0.15

ANNUAL OPERATING COST $ MM/YR

	CGSB Octanes		Market Octanes	
	Case2	Case3	Case2	Case3
Capital Charges (25%)	0.13	0.04	0.4	0.04
Insurance (0.5%)	-	-	-	-
Local Taxes (1.0%)	-	-	-	-
Maintenance (5.5%	-	-	-	-
Process Operating Cost (Incremental Total)	-10.19	1.7	-6.82	0.61
Total	-10.06	1.74	-6.42	0.65
Incremental Annual Operating Cost (Case1 - BASE)	-10.06	1.74	-6.42	0.65

TABLE 8 - 75

ANNUAL OPERATING COST

REGION: CANADA

	CGSB Octanes		Market Octanes	
CAPITAL EQUIPMENT COST - $ MM/YR	Case2	Case3	Case2	Case3
Isomerization Units	96.07	-	202.77	180.19
Offsites	26.46	-	56.33	49.88
Crude Inventory	3.59	2.59	4.84	0.99
Total	126.13	2.59	263.94	231.06

ANNUAL OPERATING COST $ MM/YR

	CGSB Octanes		Market Octanes	
	Case2	Case3	Case2	Case3
Capital Charges (25%)	31.54	0.64	65.98	57.76
Insurance (0.5%)	0.62	-	1.32	1.16
Local Taxes (1.0%)	1.24	-	2.63	2.31
Maintenance (5.5%	6.83	-	14.42	12.70
Process Operating Cost (Incremental Total)	0.57	11.70	7.78	15.29
Total	40.80	12.34	92.13	89.22
Incremental Annual Operating Cost (Case1 - BASE)	40.80	12.34	35.067	32.157

TABLE 8 - 76

SUMMARY OF ANNUAL INCREMENTAL OPERATING COSTS

(CASE - BASE)

REGION: CANADA

REGION	CGSB OCTANES MM $/YR		MARKET OCTANES MM $/YR	
	CASE 2	CASE 3	CASE 2	CASE 3
ATLANTIC	6.49	0.07	2.592	2.822
QUEBEC	22.10	10.54	25.585	15.205
ONTARIO	22.27	-0.01	13.31	13.48
WESTERN	-10.06	1.74	-6.42	0.65
CANADA	40.80	12.34	35.067	32.157

CONCLUSIONS

(ADDITIONAL STUDY CASES)

Eliminating MMT antiknock additive from unleaded motor gasoline or changing grade split as studied in the four additional cases will require more severe operation of existing, as well as the addition of, new octane improvement facilities with attendent costs and energy penalties.

The overall incremental cost to the oil refining industry in 1990 for the additional cases studied is as follows:

(1st quarter 1984 dollars)

	CSGB OCTANES		MARKET OCTANES	
	CASE 2	CASE 3	CASE 2	CASE 3
Capital cost $	126,130,000	2,590,000	85,580,000	52,730,000
Annual Operating Cost $ (including cost of capital)	40,800,000	12,340,000	35,067,000	32,157,000

The study constraints were maximum use of existing equipment and minimum crude oil consumption. In arriving at the above costs priority was first given to maximum use of existing equipment. If existing equipment could not meet octane requirements and additional equipment was shown to be needed, then the new combination of processes was operated for minimum crude consumption.

It is recognized, therefore, that more definitive evaluation of the individual refineries may show some reduction in capital investment at the expense of increased crude oil requirements and energy penalties.

Since no allowance was made in the simulation for any octane give away due to reduced blending flexibility in the absence of MMT additive, these costs, from a study standpoint, may be considered to be the minimum that will be required. To maintain control of blending, the refineries may have to carry larger inventories of the higher octane components, run catalytic reforming at maximum severity or add additional selective processing to separate a blending component of significantly higher octane than those used in the study. All of these carry additional costs and processing penalties over those presented. An overview of processing severity and selectivity is given in Section 5.2.

A complete assessment of all the various possibilities would have to be carried out to determine the optimum solution for any particular location.

The Western region, however, is of particular interest. The area contains 11 refineries made up of several large refineries in the Prairie provinces and a number of smaller refineries on the West Coast and in the interior of British Columbia.

The study showed that all additional cases could be met without the addition of new processing equipment.

While allowance was made for the higher octane requirements in the B.C. market area, the greater processing capabilities of the larger more modern refineries in the prairies may have overshadowed the real effect that withdrawal of MMT or changing grade split would have on smaller, older refineries in British Columbia.

9. - INDEX

REFINERY SIMULATIONS

A - CGSB OCTANES

RUN			
ATLBAS 41	18 mg/l	Mn	70/30 split
ATLBAS 40	0 MMT		90/10 split
QUEBAS 41	18 mg/l	Mn	70/30 split
QUEBAS 40	0 MMT		90/10 split
ONTBAS 41	18 mg/l	Mn	70/30 split
ONTBAS 40	0 MMT		90/10 split
WESBAS 41	18 mg/l	Mn	70/30 split
WESBAS 40	0 MMT		90/10 split

B - MARKET OCTANES

RUN			
ATLBAS 11	18 mg/l	Mn	70/30 split
ATLBAS 10	0 MMT		90/10 split
QUEBAS 11	18 mg/l	Mn	70/30 split
QUEBAS 10	0 MMT		90/10 split
ONTBAS 11	18 mg/l	Mn	70/30 split
ONTBAS 10	0 MMT		90/10 split
WESBAS 11	18 mg/l	Mn	70/30 split
WESBAS 10	0 MMT		90/10 split

9. - INDEX

REFINERY SIMULATIONS

ADDITIONAL CASES

C - CGSB OCTANES

RUN			
ATLBAS 50	0 MMT		70/30 split
ATLBAS 51	18 mg/l	Mn	90/10 split
QUEBAS 50	0 MMT		90/10 split
QUEBAS 51	18 mg/l	Mn	70/30 split
ONTBAS 50	0 MMT		90/10 split
ONTBAS 51	18 mg/l	Mn	70/30 split
WESBAS 50	0 MMT		90/10 split
WESBAS 51	18 mg/l	Mn	70/30 split

D - MARKET OCTANES

RUN			
ATLBAS 20	0 MMT		70/30 split
ATLBAS 21	18 mg/l	Mn	90/10 split
QUEBAS 20	0 MMT		90/10 split
QUEBAS 21	18 mg/l	Mn	70/30 split
ONTBAS 20	0 MMT		90/10 split
ONTBAS 21	18 mg/l	Mn	70/30 split
WESBAS 20	0 MMT		90/10 split
WESBAS 21	18 mg/l	Mn	70/30 split

"A"

```
TIME:11.03.05 DATE:TUESDAY 11984122 31
          REFINERY SIMULATION PROGRAM
          CASE:ATLRA841 REGION:ATLANTIC
           **** FEED BLEND ****
            CRUDE ORIGIN               LV %          BPCD
             FRONTIER                  33            44736.5
             VENEZL                    7             9488.29
             ARABL                     30.6          41477.4
             SYNCRUDE                  15            20332.1
             MEXL                      9.9           13419.2
             NORTHSEA                  4.5           6099.62
             No. NBP            LV %      S.G.       API          SULFUR WT%  BPCD        Lbs/hr FEED     Lbs/hr SULFUR
              Total             100                                           135547       1.7126E+06      20596.3
              Average                  .867354    31.6399        1.20263

              **** MATERIAL BALANCE ****

                        CRUDE UNIT
             No. Name           BPCD       Lbs/hr       IBP        EBP        S.G.      API         SULFUR WT%  Lbs/hr Su
                          *** FEED ***
             0   CRUDE FEED     135547     1.7126E+06   60         1360       .867353   31.64        1.20263     20596.3
                          *** PRODUCT ***
             2   OVERHEAD       8661.55    80922.8      60         170.322    .641365   89.1234      .0145586    11.7813
             28  LSR            6481.08    63019.7      60         170.322    .667511   80.4815      .0187849    11.8382
             3   NAPHTHA        12475.7    132364       170.322    280.176    .728341   62.7771      .0234412    31.0277
             4   KEROSENE       35828.8    422344       280.176    540        .809215   43.3608      .174053     735.102
             5   LGO            16918.7    214548       540        660        .870536   31.0435      .767538     1646.74
             1   REDUCED CRUDE  61662.2    862422       660        1360       .960131   15.8757      2.10705     18171.7

                        VACUUM UNIT
             No. Name           BPCD       Lbs/hr       IBP        EBP        S.G.      API         SULFUR WT%  Lbs/hr Su
                          *** FEED ***
             32  REDUCED CRUDE  61662.2    862422       660        1360       .960131   15.8757      2.10705     18171.7
                          *** PRODUCT ***
             6   HVGO           43663      585558       660        1050       .920633   22.1986      1.3757      8055.53
             7   RESIDUUM       17999.2    276864       1050       1360       1.05595   2.50256      3.65395     10116.5

                        CAT CRACKER
             No. Name           BPCD       Lbs/hr       IBP        EBP        S.G.      API         SULFUR WT%  Lbs/hr Su
                          *** FEED ***
             65  LGO            0          0            540        660        .870536   31.0435      .767538     0
             64  HVGO           43600      584714       660        1050       .920633   22.1986      1.3757      8043.9
                          *** TOTAL FEED ***
             8   FCCU FEED      43600      584714       540        1050       .920633   22.1986      1.3757      8043.9
                          *** PRODUCT ***
             12  LCO            11266.2    157834       430        650        .961731   15.6305      1.72064     2715.76
             13  HCO            2816.56    43022        650        787.405    1.04858   3.44441      2.71861     1169.6
             14  CRACKED GAS    21761.5    236915                             .748055   57.6572      .181333     429.605
             39  C3/C4 -FCCU    8575.44    70463.1                            .564073   119.354      0           0
            *** PRODUCT ***
            < 18 > LE FROM CAT CRACKER (FOE)= 2604.38
            AVAILABLE C3/C4 OLEFINS= 8575.44
            CONVERSION Wt%= 65.6487     CONVERSION Vol %= 67.7
            COKE, WT% 8.2139
            COKE  ,#/HR 48052.5         Sulfur in Flue Gas,Lbs/hr= 329.278
```

```
                 CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 8575.44
*** PRODUCT ***
< 15 > POLYMER= 3500.9
< 16 > LE FROM POLY (FOE)= 2690.58

                 ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 0
< 62 > C3/C4 TO ALKYL= 0
< 20 > I-C4 FR. GAS PLANT= 0
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 0
< 63 > LE FROM ALKYL (FOE)= 0

                 CATALYTIC REFORMER UNIT
No. Name            BPCD        Lbs/hr         IBP          EBP          S.G.       API           SULFUR WT%  Lbs/hr Su
                 *** FEED ***
 9  REFORMER FEED 9600          101854         170.322      280.176      .728341    62.7771        0           0
                 *** PRODUCT ***
 17 REFORMATE      7661.83      86856.7                                  .778217    50.3258        0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 1736.55
CONVERSION(LV%)= 79.8107    Severity (RON Clear)= 94    FEED KW= 12.1621

                 GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 8661.55
< 57 > LE FROM REFORMER (FOE)= 1736.55
< 18 > LE FROM CAT CRACKER (FOE)= 2604.38
< 16 > LE FROM POLY (FOE)= 2690.58
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 5300.05
< 20 > I-C4 FR. GAS PLANT= 0
< 49 > REF C4 TO BLENDING = 2762.38
< 69 > LSR= 6287.37

                 ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 6287.37
*** PRODUCT ***
< 29 > LSR+ISO= 6287.37

*** BY-PASS= 100 %   ***

                 GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 6287.37
< 26 > REFORMATE= 7661.83
< 50 > ALKYLATE= 0
< 15 > POLYMER= 3500.9
< 14 > CRACKED GAS= 21741.5
< 49 > REF C4 TO BLENDING = 2762.38
< 68 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 12580
```

```
        < 23 > UNLEADED REGULAR= 26418
        < 24 > UNLEADED PREMIUM= 2956
        < 25 > AVIATION GASOLINE= 0

        *** GASOLINE COMPOSITION ***

                  LR            UR            UP            AV

LSR               .268387       .11023        0             0
CRACKED GAS       .468261       .6            0             0
REFORMATE         .206894       .0879098      .92581        0
POLYMER           0             .132519       0             0
ALKYLATE          0             0             0             .9786
C4                .0564572      .0693409      .0741903      .0214

                        TURBO FUEL BLENDING
        *** FEED ***
        < 30 > LSR= 193.71
        < 58 > NAPHTHA= 1527.75
        < 59 > KEROSENE= 4442.55
        *** PRODUCT ***
        < 42 > JET FUEL B= 1761
        < 43 > JET FUEL A= 4403

        *** TURBO FUEL COMPOSITION ***

                        NAPHTHA BASE  KEROSENE BASE

        LSR             .11           0
        NAPHTHA         .48           .155
        KEROSENE        .41           .845

                        DISTILLATE BLENDING
        *** FEED ***
        < 60 > KEROSENE= 31386.3
        < 40 > LGO= 16918.5
        < 38 > LCO= 8683.24
        *** PRODUCT ***
        < 44 > STOVE OIL= 2390
        < 45 > LIGHT FUEL OIL= 26607
        < 46 > DIESEL FUEL= 27991

        *** DISTILLATE COMPOSITION ***

                        STOVE OIL     DIESEL FUEL    LFO

        KEROSENE        1             .607           .451225
        LCO             0             .139           .180121
        LGO             0             .254           .368654

                        HEAVY FUEL OIL BLENDING
        *** FEED ***
        < 41 > LGO= .229248
        < 35 > LCO= 2583
        < 13 > HGO= 2816.56
        < 37 > HVGO= 0
        < 31 > REDUCED CRUDE= 0
        < 34 > VAC RESIDUUM= 8501.21
```

```
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 13901

          OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 0
< 36 > HVGO TO LUBE OIL= 63
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 9498
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 1348
< 67 > VGO PETROCHEMICAL FEED= 0

                        DISTILLATE DESULFURIZATION

STREAM              TOTAL              FEED  TO  DDS                                   FINAL STREAM
                    BPCD         BPCD       Lbs/hr     SULFUR WT%          % BYPASS    SULFUR WT%
KEROSENE            35828.8      35828.8    422344     .174053             0           8.71707E-03
LGO                 16918.7      16918.7    214548     .767538             0           .0772877
LCO                 11266.2      7886.37    110484     1.72064             29.9997     .64361
HCO                 2816.56      0          0          2.71861             100         2.71861
VAC RESIDUUM        8501.21      0          0          3.65395             100         3.65395


   ***PRODUCT SLATES & SPECIFICATIONS***

                 JET FUEL B   JET FUEL A   STOVE OIL     LFO          DIESEL FUEL   HFO

BPCD              1761         4403         2390          26607        27991         13901
S.G.              .754808      .79668       .809215       .859293      .86599        1.03695
ASTM 10%          207.037      288.204      351.738       379.771      365.853
ASTM 20%          223.755      319.815      368.14        421.939      398.955
ASTM 50%          268.955      393.719      415.548       525.497      484.551
ASTM 90%          471.652      493.722      497.527       610.724      603.371
RVP,psia          2.31506
Sulfur Wt %       .0165099     .0107912     8.70266E-03   .160706      .125713       2.94227
Flash Point,F     64.6157      102.201      129.046       144.607      138.326
Pour Point,F     -79.7885     -54.2954     -44.1417      -29.9256     -35.6821
Cetane No.                                                             44.8894
Visc @100F,cs     .796948      1.26686      1.5093        2.62049      2.19975       1221.66
Visc @122F,cs     .702946      1.09515      1.29361       2.16959      1.84238       463.185
Watsons K         12.0468      11.8554      11.8137       11.4716      11.5483       10.8107
MeABP             291.844      382.566      413.68        497.847      472.502       948.87

                 GASOLINE

LEADED REGULAR,BPCD            12580
TEL Addition,cc/IG: 1.24
RON / MON / (R+M)/2 (Clear)    87.0715 / 78.3686 / 82.7201
RON / MON / (R+M)/2            91.698 / 82.1707 / 86.9344
RVP,psia                       10.2104

MMT Addition,mg/l: 18
UNLEADED REGULAR,BPCD          26418
RON / MON / (R+M)/2            92.3 / 81.8437 / 87.0718
RVP,psia                       9.99489

UNLEADED PREMIUM,BPCD          2956
```

```
RON / MON / (R+M)/2            95.1309 / 85.0009 / 90.0699
RVP,psia                       9.87528

AVIATION GASOLINE,BPCD         0
RON / MON / (R+M)/2            93 / 90.8 / 91.9
RVP,psia                       10
```

STREAMS

```
< 0 > CRUDE FEED= 135547                        < 1 > REDUCED CRUDE= 61662.2
< 2 > OVERHEAD= 8661.55                         < 3 > NAPHTHA= 12475.7
< 4 > KEROSENE= 35828.8                         < 5 > LGO= 16918.7
< 6 > HVGO= 43663                               < 7 > RESIDUUM= 17999.2
< 8 > FCCU FEED= 43600                          < 9 > REFORMER FEED= 9600
< 10 > CAT POLY FEED= 8575.44                   < 11 > ALKYLATION FEED= 0
< 12 > LCO= 11266.2                             < 13 > HCO= 2816.56
< 14 > CRACKED GAS= 21741.5                     < 15 > POLYMER= 3500.9
< 16 > LE FROM POLY (FOE)= 2690.58              < 17 > REFORMATE= 7661.83
< 18 > LE FROM CAT CRACKER (FOE)= 2604.38       < 19 > FUEL GAS (FOE)= 5300.05
< 20 > I-C4 FR. GAS PLANT= 0                    < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 12580                    < 23 > UNLEADED REGULAR= 26418
< 24 > UNLEADED PREMIUM= 2956                   < 25 > AVIATION GASOLINE= 0
< 26 > REFORMATE= 7661.83                       < 27 > NAPHTHA SPECIALTIES= 0
< 28 > LSR= 6481.08                             < 29 > LSR+ISO= 6287.37
< 30 > LSR= 193.71                              < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 61662.2                   < 33 > VAC RESID TO ASPHALT PLANT= 9498
< 34 > VAC RESIDUUM= 8501.21                    < 35 > LCO= 2583
< 36 > HVGO TO LUBE OIL= 63                     < 37 > HVGO= 0
< 38 > LCO= 8683.24                             < 39 > C3/C4 -FCCU= 8575.44
< 40 > LGO= 16918.5                             < 41 > LGO= .229248
< 42 > JET FUEL B= 1761                         < 43 > JET FUEL A= 4403
< 44 > STOVE OIL= 2390                          < 45 > LIGHT FUEL OIL= 26607
< 46 > DIESEL FUEL= 27991                       < 47 > HEAVY FUEL OIL= 13901
< 48 > RESID TO COKING= 0                       < 49 > REF C4 TO BLENDING = 2762.38
< 50 > ALKYLATE= 0                              < 51 > CRUDE LIGHT ENDS= 1.60865
< 52 > TOTAL PRODUCT= 129916                    < 53 > C2 % IN CRUDE FEED= .02451
< 54 > C3 % IN CRUDE FEED= .31962               < 55 > I-C4 % IN CRUDE FEED= .19662
< 56 > N-C4 % IN CRUDE FEED= 1.0679             < 57 > LE FROM REFORMER (FOE)= 1736.55
< 58 > NAPHTHA= 1527.75                         < 59 > KEROSENE= 4442.55
< 60 > KEROSENE= 31386.3                        < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 0                        < 63 > LE FROM ALKYL (FOE)= 0
< 64 > HVGO= 43600                              < 65 > LGO = 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 1348         < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                           < 69 > LSR= 6287.37
```

```
                                 LIGHT ENDS BALANCE

                                   *** FROM ***
               CRUDE UNIT     REFORMER      CAT CRACKER   POLY        ALKYL       ISO         TOTAL
C2  ,#/HR       174.219       1332.89       8250.92        0           0           0           9758.03
C3  ,#/HR       3205.94       3536.2        7361.38        7576.02     0           0           21659.5
IC4   ,#/HR     2193.4        2205.41       17330.9        18740.1     0           0           40469.8
NC4   ,#/HR     12335.7       3218.57       7019.88        7019.88     0           0           29594
H2  ,#/HR       0             3370.82       3288.63        0           0           0           6579.45
C1  ,#/HR       0             1332.89       3421.11        0           0           0           4754
H2S   ,#/HR     0             0             3612.14        0           0           0           3612.14
C2=   ,#/HR     0             0             5031.05        0           0           0           5031.05
C3=   ,#/HR     0             0             17285.9        0           0           0           17285.9
C4=   ,#/HR     0             0             26462.5        0           0           0           26462.5
TOTAL   ,#/HR   17909.3       14996.8       98964.4        33336       0           0           165206
BPCD (FOE)      1446.8        1736.55       8169.86        2690.57     0           0           14043.8

                                   *** TO ***
               POLY           ALKY          GAS BLEND     FC FEED     DDS         FUEL GAS    TOTAL
C2  ,#/HR       0             0             0              0           0           9758.03     9758.03
C3  ,#/HR       6166.76       0             0              0           0           15492.8     21659.5
IC4   ,#/HR     17330.9       0             11705.7        0           0           11433.2     40469.8
NC4   ,#/HR     7019.88       0             11420          0           0           11154.2     29594
H2  ,#/HR       0             0             0              0           5500.29     1079.16     6579.45
C1  ,#/HR       0             0             0              0           0           4754        4754
H2S   ,#/HR     0             0             0              0           0           3612.14     3612.14
C2=   ,#/HR     0             0             0              0           0           5031.05     5031.05
C3=   ,#/HR     13483         0             0              0           0           3802.9      17285.9
C4=   ,#/HR     26462.5       0             0              0           0           0           26462.5
TOTAL   ,#/HR   70463.1       0             23125.7        0           5500.29     66117.4     165206
BPCD (FOE)      5614.42       0             1859.85        0           1269.47     5300.05     14043.8
```

```
                           **** OVERALL MASS BALANCE ****
*** FEED ***

                           BPCD                     #/HR

CRUDE                       135547                   1.7126E+06
BUTANE                      0                        0
TOTAL                       135547                   1.7126E+06


*** PRODUCT ***

FUEL GAS (FOE)              5300.05                  66117.4
MOTOR GASOLINE              41954                    445161
AVIATION TURBO FUELS        6164                     70460.6
DISTILLATES                 56988                    706169
HEAVY FUEL OIL              13901                    209978
OTHER PRODUCTS              10909                    161245
H2 TO DESULFURIZERS (FOE)   1269.47                  5500.29
COKE (FOE)                  2559.28                  48052.5
TOTAL                       139045                   1.71268E+06
```

```
TIME:11.49.55 DATE:TUESDAY 11984122 51
          REFINERY SIMULATION PROGRAM
         CASE:ATLRA640 REGION:ATLANTIC
          **** FEED BLEND ****
            CRUDE ORIGIN                  LV %          BPCD
             FRONTIER                     33           44862.1
             VENEZL                       7            9516.2
             ARABL                        30.6         41599.4
             SYNCRUDE                     15           20391.8
             MEXL                         9.9          13458.6
             NORTHSEA                     4.5          6117.55
              No.  MBP              LV %       S.G.          API          SULFUR WT%  BPCD          Lbs/hr FEED     Lbs/hr SULFUR
              Total                 100                                              135946         1.71764E+06     20656.9
              Average                       .867354      31.6399         1.20263

               **** MATERIAL BALANCE ****

                      CRUDE UNIT
            No. Name         BPCD         Lbs/hr        IBP          EBP          S.G.        API           SULFUR WT%  Lbs/hr Su
                         *** FEED ***
            0   CRUDE FEED   135946       1.71764E+06   60           1360         .867352     31.6402        1.20263     20656.9
                         *** PRODUCT ***
            2   OVERHEAD     8659.74      80885.6       60           170.026      .641204     89.1785        .0145871    11.7988
            20  LSR          6472.86      62927.3       60           170.026      .667379     80.5235        .018782     11.819
            3   NAPHTHA      12525.7      132876        170.026      280.063      .728242     62.8035        .0234168    31.1154
            4   KEROSENE     35948.2      423741        280.063      540          .809196     43.3649        .174003     737.323
            5   LGO          16968.5      215179        540          660          .870536     31.0435        .767538     1651.58
            1   REDUCED CRUDE 61843.5     864957        660          1360         .960131     15.8757        2.10705     18225.1

                      VACUUM UNIT
            No. Name         BPCD         Lbs/hr        IBP          EBP          S.G.        API           SULFUR WT%  Lbs/hr Su
                         *** FEED ***
            32  REDUCED CRUDE 61843.5     864957        660          1360         .960131     15.8757        2.10705     18225.1
                         *** PRODUCT ***
            6   HVGO         43793        587302        660          1050         .920633     22.1986        1.3757      8079.51
            7   RESIDUUM     18050.5      277653        1050         1360        1.05595      2.50256        3.65395     10145.3

                      CAT CRACKER
            No. Name         BPCD         Lbs/hr        IBP          EBP          S.G.        API           SULFUR WT%  Lbs/hr Su
                         *** FEED ***
            65  LGO          0            0             540          660          .870536     31.0435        .767538     0
            64  HVGO         43730        586457        660          1050         .920633     22.1986        1.3757      8067.89
                         *** TOTAL FEED ***
            8   FCCU FEED    43730        586457        540          1050         .920633     22.1986        1.3757      8067.89
                         *** PRODUCT ***
            12  LCO          11089.9      155484        430          650          .96247      15.5176        1.74048     2706.16
            13  HCO          2772.48      42418.6       650          784.982     1.05031      3.22214        2.74995     1166.49
            14  CRACKED GAS  21935        239024                                  .748055     57.6572        .179053     427.98
            39  C3/C4 -FCCU  8706.3       71540.3                                 .564088     119.347        0           0
           *** PRODUCT ***
           < 18 > LE FROM CAT CRACKER (FOE)= 2668.18
           AVAILABLE C3/C4 OLEFINS= 8706.3
           CONVERSION Wt%= 66.2545       CONVERSION Vol %= 68.3
           COKE, WT% 8.33946
           COKE  ,#/HR 48932.5           Sulfur in Flue Gas,Lbs/hr= 335.18
```

```
                CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 8706.3
*** PRODUCT ***
< 15 > POLYMER= 3553.68
< 16 > LE FROM POLY (FOE)= 2732.35

                ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 0
< 62 > C3/C4 TO ALKYL= 0
< 20 > I-C4 FR. GAS PLANT= 0
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 0
< 63 > LE FROM ALKYL (FOE)= 0

                CATALYTIC REFORMER UNIT
No. Name            BPCD        Lbs/hr        IBP          EBP         S.G.        API          SULFUR WT%  Lbs/hr Su
                *** FEED ***
 9  REFORMER FEED 9650          102370        170.026      280.063     .728242     62.8035       0           0
                *** PRODUCT ***
 17 REFORMATE     7515.13       85783.1                                .783601     49.0765       0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 1936.13
CONVERSION(LV%)= 77.877     Severity (RON Clear)= 96    FEED KW= 12.1627

                GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 8659.74
< 57 > LE FROM REFORMER (FOE)= 1936.13
< 18 > LE FROM CAT CRACKER (FOE)= 2668.18
< 16 > LE FROM POLY (FOE)= 2732.35
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 5750.72
< 20 > I-C4 FR. GAS PLANT= 0
< 49 > REF C4 TO BLENDING = 2771.5
< 69 > LSR= 6279.15

                ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 6279.15
*** PRODUCT ***
< 29 > LSR+ISO= 6178.68

*** BY-PASS= 0 %   ***

                GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 6178.68
< 26 > REFORMATE= 7515.13
< 50 > ALKYLATE= 0
< 15 > POLYMER= 3553.68
< 14 > CRACKED GAS= 21935
< 49 > REF C4 TO BLENDING = 2771.5
< 68 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 4195
```

```
     < 23 > UNLEADED REGULAR= 34803
     < 24 > UNLEADED PREMIUM= 2956
     < 25 > AVIATION GASOLINE= 0

     *** GASOLINE COMPOSITION ***

                  LR           UR           UP           AV

LSR               .539943      .112451      0            0
CRACKED GAS       .224833      .58          .272692      0
REFORMATE         .200012      .136475      .651671      0
POLYMER           0            .102109      0            0
ALKYLATE          0            0            0            .9786
C4                .0352119     .0689655     .0756379     .0214

                  TURBO FUEL BLENDING
     *** FEED ***
     < 30 > LSR= 193.71
     < 58 > NAPHTHA= 1527.75
     < 59 > KEROSENE= 4442.55
     *** PRODUCT ***
     < 42 > JET FUEL B= 1761
     < 43 > JET FUEL A= 4403

     *** TURBO FUEL COMPOSITION ***

                  NAPHTHA BASE  KEROSENE BASE

     LSR          .11           0
     NAPHTHA      .48           .155
     KEROSENE     .41           .845

                  DISTILLATE BLENDING
     *** FEED ***
     < 60 > KEROSENE= 31505.6
     < 40 > LGO= 16967.5
     < 38 > LCO= 8514.93
     *** PRODUCT ***
     < 44 > STOVE OIL= 2390
     < 45 > LIGHT FUEL OIL= 26607
     < 46 > DIESEL FUEL= 27991

     *** DISTILLATE COMPOSITION ***

                  STOVE OIL     DIESEL FUEL   LFO

     KEROSENE     1             .607          .455709
     LCO          0             .139          .173796
     LGO          0             .254          .370495

                  HEAVY FUEL OIL BLENDING
     *** FEED ***
     < 41 > LGO= .987061
     < 35 > LCO= 2575
     < 13 > HCO= 2772.48
     < 37 > HVGO= 0
     < 31 > REDUCED CRUDE= 0
     < 34 > VAC RESIDUUM= 8552.53
```

```
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 13901

            OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 0
< 36 > HVGO TO LUBE OIL= 63
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 9498
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 1348
< 67 > VGO PETROCHEMICAL FEED= 0

                          DISTILLATE DESULFURIZATION

STREAM                 TOTAL                  FEED  TO  DDS                                    FINAL STREAM
                       BPCD         BPCD        Lbs/hr     SULFUR WT%               % BYPASS     SULFUR WT%
KEROSENE               35948.2      35948.2     423741      .174003                 0            8.71456E-03
LGO                    16968.5      16968.5     215179      .767538                 0            .0772877
LCO                    11089.9      7762.95     108839      1.74048                 29.9998      .651114
HCO                    2772.48      0           0           2.74995                 100          2.74995
VAC RESIDUUM           8552.53      0           0           3.65395                 100          3.65395


   ***PRODUCT SLATES & SPECIFICATIONS***

               JET FUEL B   JET FUEL A    STOVE OIL      LFO          DIESEL FUEL   HFO

BPCD           1761         4403          2390           26607        27991         13901
S.G.           .754738      .796648       .809196        .858561      .846082       1.0375
ASTM 10%       206.861      288.039       351.646        379.136      368.76
ASTM 20%       223.587      319.689       368.065        421.13       398.882
ASTM 50%       268.828      393.667       415.499        524.949      484.533
ASTM 90%   .   471.636      493.713       497.518        610.728      603.373
RVP,psia       2.8026
Sulfur Wt %    .0164968     .0107854      8.70016E-03    .158036      .126936       2.95397
Flash Point,F  64.5172      102.11        128.996        144.254      138.276
Pour Point,F  -79.8131     -54.3223      -44.1609       -29.6624     -35.7828
Cetane No.                                                            44.8498
Visc @100F,cs  .796471      1.2663        1.50864        2.60917      2.1995        1272.06
Visc @122F,cs  .702542      1.0947        1.29323        2.16107      1.84214       478.679
Watsons K      12.0473      11.8555       11.8137        11.4793      11.5469       10.8088
MeABP          291.718      382.486       413.627        497.334      472.463       950.35

               GASOLINE

LEADED REGULAR,BPCD          4195
TEL Addition,cc/IG: 1.24
RON / MON / (R+M)/2 (Clear)  84.9992 / 78.7942 / 81.8967
RON / MON / (R+M)/2          90.3824 / 83.5573 / 86.9699
RVP,psia                     12.4889

MMT Addition,mg/l: 0
UNLEADED REGULAR,BPCD        34803
RON / MON / (R+M)/2          91.9 / 82.1494 / 87.0247
RVP,psia                     10.3958

UNLEADED PREMIUM,BPCD        2956
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RON / MON / (R+M)/2           95 / 85.1105 / 90.0553
RVP,psia                      9.84973

AVIATION GASOLINE,BPCD        0
RON / MON / (R+M)/2           93 / 90.8 / 91.9
RVP,psia                      10


                    STREAMS

< 0 > CRUDE FEED= 135946                    < 1 > REDUCED CRUDE= 61843.5
< 2 > OVERHEAD= 8659.74                     < 3 > NAPHTHA= 12525.7
< 4 > KEROSENE= 35948.2                     < 5 > LGO= 16968.5
< 6 > HVGO= 43793                           < 7 > RESIDUUM= 18050.5
< 8 > FCCU FEED= 43730                      < 9 > REFORMER FEED= 9650
< 10 > CAT POLY FEED= 8706.3                < 11 > ALKYLATION FEED= 0
< 12 > LCO= 11089.9                         < 13 > HCO= 2772.48
< 14 > CRACKED GAS= 21935                   < 15 > POLYMER= 3553.68
< 16 > LE FROM POLY (FOE)= 2732.35          < 17 > REFORMATE= 7515.13
< 18 > LE FROM CAT CRACKER (FOE)= 2668.18   < 19 > FUEL GAS (FOE)= 5750.72
< 20 > I-C4 FR. GAS PLANT= 0                < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 4195                 < 23 > UNLEADED REGULAR= 34803
< 24 > UNLEADED PREMIUM= 2956               < 25 > AVIATION GASOLINE= 0
< 26 > REFORMATE= 7515.13                   < 27 > NAPHTHA SPECIALTIES= 0
< 28 > LSR= 6472.86                         < 29 > LSR+ISO= 6178.68
< 30 > LSR= 193.71                          < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 61843.5               < 33 > VAC RESID TO ASPHALT PLANT= 9498
< 34 > VAC RESIDUUM= 8552.53                < 35 > LCO= 2575
< 36 > HVGO TO LUBE OIL= 63                 < 37 > HVGO= 0
< 38 > LCO= 8514.93                         < 39 > C3/C4 -FCCU= 8706.3
< 40 > LGO= 16967.5                         < 41 > LGO= .987061
< 42 > JET FUEL B= 1761                     < 43 > JET FUEL A= 4403
< 44 > STOVE OIL= 2390                      < 45 > LIGHT FUEL OIL= 26607
< 46 > DIESEL FUEL= 27991                   < 47 > HEAVY FUEL OIL= 13901
< 48 > RESID TO COKING= 0                   < 49 > REF C4 TO BLENDING = 2771.5
< 50 > ALKYLATE= 0                          < 51 > CRUDE LIGHT ENDS= 1.60865
< 52 > TOTAL PRODUCT= 129916                < 53 > C2 % IN CRUDE FEED= .02451
< 54 > C3 % IN CRUDE FEED= .31962           < 55 > I-C4 % IN CRUDE FEED= .19662
< 56 > N-C4 % IN CRUDE FEED= 1.0679         < 57 > LE FROM REFORMER (FOE)= 1936.13
< 58 > NAPHTHA= 1527.75                     < 59 > KEROSENE= 4442.55
< 60 > KEROSENE= 31505.6                    < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 0                    < 63 > LE FROM ALKYL (FOE)= 0
< 64 > HVGO= 43730                          < 65 > LGO = 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 1348     < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                       < 69 > LSR= 6279.15
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                         LIGHT ENDS BALANCE

                           *** FROM ***
              CRUDE UNIT   REFORMER    CAT CRACKER  POLY       ALKYL     ISO        TOTAL
C2   ,#/HR    174.732      1527.79     8468.41      0          0         0          10170.9
C3   ,#/HR    3215.37      3963.49     7466.76      7702.88    0         232.329    22580.8
IC4   ,#/HR   2199.85      2334.86     17598.5      19029.3    0         413.419    41575.9
NC4   ,#/HR   12371.9      3407.49     7121.31      7121.31    0         1177.22    31199.2
H2   ,#/HR    0            3825.59     3296.79      0          0         0          7122.38
C1   ,#/HR    0            1527.79     3511.29      0          0         0          5039.08
H2S   ,#/HR   0            0           3646.58      0          0         0          3646.58
C2=   ,#/HR   0            0           5163.66      0          0         0          5163.66
C3=   ,#/HR   0            0           17515.5      0          0         0          17515.5
C4=   ,#/HR   0            0           26886.3      0          0         0          26886.3
TOTAL   ,#/HR 17961.9      16587       100675       33853.5    0         1822.97    170900
BPCD (FOE)    1451.05      1936.13     8319.04      2732.35    0         147.033    14585.6

                           *** TO ***
              POLY         ALKY        GAS BLEND    PC FEED    DDS       FUEL GAS   TOTAL
C2   ,#/HR    0            0           0            0          0         10170.9    10170.9
C3   ,#/HR    6272.08      0           0            0          0         16308.8    22580.8
IC4   ,#/HR   17598.5      0           11579.7      0          0         12397.7    41575.9
NC4   ,#/HR   7121.31      0           11628.2      0          0         12449.7    31199.2
H2   ,#/HR    0            0           0            0          5494.48   1627.9     7122.38
C1   ,#/HR    0            0           0            0          0         5039.08    5039.08
H2S   ,#/HR   0            0           0            0          0         3646.58    3646.58
C2=   ,#/HR   0            0           0            0          0         5163.66    5163.66
C3=   ,#/HR   13662.1      0           0            0          0         3853.4     17515.5
C4=   ,#/HR   26886.3      0           0            0          0         0          26886.3
TOTAL   ,#/HR 71540.3      0           23207.9      0          5494.48   70657.8    170900
BPCD (FOE)    5700.26      0           1866.5       0          1268.13   5750.72    14585.6
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                         **** OVERALL MASS BALANCE ****
*** FEED ***

                         BPCD                      #/HR

CRUDE                     135946                    1.71764E+06
BUTANE                   0                         0
TOTAL                     135946                    1.71764E+06


*** PRODUCT ***

FUEL GAS (FOE)            5750.72                   70657.8
MOTOR GASOLINE            41954                     444923
AVIATION TURBO FUELS      6164                      70456.7
DISTILLATES               56988                     705923
HEAVY FUEL OIL            13901                     210089
OTHER PRODUCTS            10909                     161243
H2 TO DESULFURIZERS (FOE) 1268.13                   5494.48
COKE (FOE)                2606.14                   48932.5
TOTAL                     139541                    1.71772E+06
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TIME:08.55.39 DATE:TUESDAY 11984122 51
        REFINERY SIMULATION PROGRAM
        CASE:QUEBA641 REGION:QUEBEC
         **** FEED BLEND ****
          CRUDE ORIGIN                 LV %          BPCD
           FRONTIER                    16.8          46127.8
           VENEZN                      11.65         31987.5
           ARABH                       6.95          19082.7
           CANDNH                      27.3          74957.8
           SYNCRUDE                    16.3          44755
           MEXN                        11.6          31850.2
           CONDENSA                    9.4           25809.6
            No.  MBP           LV %       S.G.        API           SULFUR WT%  BPCD          Lbs/hr FEED      Lbs/hr SULFUR
             Total             100                                              274571          3.53734E+06      63869.4
             Average                    .884407     28.4943         1.80558

             **** MATERIAL BALANCE ****

                        CRUDE UNIT
            No. Name           BPCD        Lbs/hr         IBP          EBP          S.G.       API            SULFUR WT%  Lbs/hr Su
                           *** FEED ***
            0   CRUDE FEED     274571      3.53734E+06    60           1460         .884407    28.4943         1.80558      63869.4
                           *** PRODUCT ***
            2   OVERHEAD       23634.9     220904         60           169.419      .641624    89.0343         .040342      89.1172
            28  LSR            18580.1     179299         60           169.419      .66246     82.0978         .0498436     89.3691
            3   NAPHTHA        35981.3     387970         169.419      319.244      .740203    59.6638         .0840581     326.12
            4   KEROSENE       49902       600967         319.244      540          .826728    39.6567         .423653      2546.01
            5   LGO            32013.9     412691         540          660          .884944    28.3971         1.02294      4221.58
            1   REDUCED CRUDE 133039       1.91481E+06    660          1460         .988044    11.7123         2.96043      56686.6

                        VACUUM UNIT
            No. Name           BPCD        Lbs/hr         IBP          EBP          S.G.       API            SULFUR WT%  Lbs/hr Su
                           *** FEED ***
            32  REDUCED CRUDE 133039       1.91481E+06    660          1460         .988044    11.7123         2.96043      56686.6
                           *** PRODUCT ***
            6   HVGO           86169.5     1.18095E+06    660          1050         .940819    18.9009         1.9963       23575.2
            7   RESIDUUM       46869       733858         1050         1460         1.07487    .143829         4.51195      33111.3

                        CAT CRACKER
            No. Name           BPCD        Lbs/hr         IBP          EBP          S.G.       API            SULFUR WT%  Lbs/hr Su
                           *** FEED ***
            65  LGO            8896.5      114685         540          660          .884944    28.3971         1.02294      1173.15
            64  HVGO           80068.5     1.09733E+06    660          1050         .940819    18.9009         1.9963       21906
                           *** TOTAL FEED ***
            8   FCCU FEED      88965       1.21202E+06    540          1050         .935231    19.7995         1.9042       23079.2
                           *** PRODUCT ***
            12  LCO            16689.8     242636         430          650          .998009    10.2823         2.91624      7075.86
            13  HCO            4172.46     66114.9        650          751.897      1.08777    -1.41736        4.60767      3046.36
            14  CRACKED GAS    46168.4     505703                                   .751936    56.6809         .219494      1109.99
            39  C3/C4 -FCCU    19892.6     164100                                   .566301    118.367         0            0
           *** PRODUCT ***
           < 18 > LE FROM CAT CRACKER (FOE)= 7806.95
           AVAILABLE C3/C4 OLEFINS= 19975.3
           CONVERSION Wt%= 74.5258      CONVERSION Vol %= 76.55
           COKE, WT% 12.2711
           COKE  ,#/HR 148805           Sulfur in Flue Gas,Lbs/hr= 1152.77
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                 CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 17500
*** PRODUCT ***
< 15 > POLYMER= 7037.41
< 16 > LE FROM POLY (FOE)= 5628.85

                 ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 3643.12
< 62 > C3/C4 TO ALKYL= 2592.6
< 20 > I-C4 FR. GAS PLANT= 1050.52
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 2430.87
< 63 > LE FROM ALKYL (FOE)= 322.722

                 CATALYTIC REFORMER UNIT
No. Name            BPCD      Lbs/hr        IBP       EBP        S.G.       API         SULFUR WT%  Lbs/hr Su
                 *** FEED ***
 9  REFORMER FEED 32600       351511        169.419   319.244    .740203    59.6638      0           0
                 *** PRODUCT ***
 17 REFORMATE     27254.7     311401                             .784349    48.9045      0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOC)= 4589.26
CONVERSION(LV%)= 83.6034    Severity (RON Clear)= 90    FEED KW= 12.0559

                 GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 23634.9
< 57 > LE FROM REFORMER (FOE)= 4589.26
< 18 > LE FROM CAT CRACKER (FOE)= 7806.95
< 16 > LE FROM POLY (FOE)= 5628.85
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 15377.7
< 20 > I-C4 FR. GAS PLANT= 1050.52
< 49 > REF C4 TO BLENDING = 5355.82
< 69 > LSR= 18185.8

                 ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 18185.8
*** PRODUCT ***
< 29 > LSR+ISO= 18185.8

*** BY-PASS= 100 %   ***

                 GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 18185.8
< 26 > REFORMATE= 9705.71
< 50 > ALKYLATE= 2430.87
< 15 > POLYMER= 7037.41
< 14 > CRACKED GAS= 46168.4
< 49 > REF C4 TO BLENDING = 5355.82
< 68 > IMPORTED C4= 0
*** PRODUCT ***
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      < 22 > LEADED REGULAR= 26456
      < 23 > UNLEADED REGULAR= 53805
      < 24 > UNLEADED PREMIUM= 7925
      < 25 > AVIATION GASOLINE= 698

      *** GASOLINE COMPOSITION ***

              LR           UR           UP           AV

LSR           .297751      .19159       0            0
CRACKED GAS   .327806      .575         .827521      0
REFORMATE     .320759      .0226693     0            0
POLYMER       0            .130795      0            0
ALKYLATE      0            .0177492     .1           .9786
C4            .0536846     .0621972     .0724793     .0214

                    TURBO FUEL BLENDING
      *** FEED ***
      < 30 > LSR= 394.35
      < 58 > NAPHTHA= 3381.3
      < 59 > KEROSENE= 10942.4
      *** PRODUCT ***
      < 42 > JET FUEL B= 3585
      < 43 > JET FUEL A= 11133

      *** TURBO FUEL COMPOSITION ***

                    NAPHTHA BASE  KEROSENE BASE

      LSR            .11          0
      NAPHTHA        .555         .125
      KEROSENE       .335         .875

                    DISTILLATE BLENDING
      *** FEED ***
      < 60 > KEROSENE= 38959.6
      < 40 > LGO= 12784.9
      < 38 > LCO= 6689.83
      *** PRODUCT ***
      < 44 > STOVE OIL= 1384
      < 45 > LIGHT FUEL OIL= 20505
      < 46 > DIESEL FUEL= 36545

      *** DISTILLATE COMPOSITION ***

                    STOVE OIL     DIESEL FUEL   LFO

      KEROSENE       1             .628          .713243
      LCO            0             .05           .237141
      LGO            0             .322          .049616

                    HEAVY FUEL OIL BLENDING
      *** FEED ***
      < 41 > LGO= 10332.5
      < 35 > LCO= 10000
      < 13 > HCO= 4172.46
      < 37 > HVGO= 0
      < 31 > REDUCED CRUDE= 0
< 36 > VAC RESIDUUM= 31396
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 55901

            OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 17549
< 36 > HVGO TO LUBE OIL= 3774
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 15473
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 0
< 67 > VGO PETROCHEMICAL FEED= 2327

                              DISTILLATE DESULFURIZATION

STREAM             TOTAL                     FEED  TO  DDS                                                 FINAL STREAM
                   BPCD          BPCD           Lbs/hr      SULFUR WT%                    % BYPASS        SULFUR WT%
KEROSENE           49902         49902          600967       .423653                      0               .0212683
LGO                23117.4       23117.4        298006      1.02294                       0               .103245
LCO                16689.8       13351.9        194110      2.91624                       19.9996         .834051
HGO                4172.46       0              0           4.60767                       100             4.60767
VAC RESIDUUM       31396         0              0           4.51195                       100             4.51195


   ***PRODUCT SLATES & SPECIFICATIONS***

               JET FUEL B    JET FUEL A    STOVE OIL     LFO          DIESEL FUEL   HFO

BPCD           3585          11133         1384          20505        36545         55901
S.G.           .760637       .815912       .826728       .870234      .854038       1.02698
ASTM 10%       206.828       333.013       381.285       392.121      396.444
ASTM 30%       225.434       359.401       394.587       414.85       423.192
ASTM 50%       281.672       424.569       439.948       470.58       496.155
ASTM 90%       470.122       499.664       502.775       569.421      606.454
RVP,psia       2.39738
Sulfur Wt %    .0578869      .0283128      .0211826      .241583      .0947179      3.17476
Flash Point,F  64.4001       127.123       143.859       149.675      152.056
Pour Point,F  -85.1713      -50.4834      -44.7813      -61.2662     -31.7765
Cetane No.                                                            43.5354
Visc @100F,cs  .797813       1.50902       1.7244        2.17739      2.45229       561.345
Visc @122F,cs  .703387       1.29204       1.46562       1.81514      2.03955       243.954
Watson K       11.9527       11.7113       11.6551       11.1988      11.5044       10.8339
MeABP          291.499       412.47        434.628       465.595      488.479       917.44

               GASOLINE

LEADED REGULAR,BPCD          26456
TEL Addition,cc/IG: 1.24
RON / MON / (R+M)/2 (Clear)  86.9312 / 78.5814 / 82.7563
RON / MON / (R+M)/2          91.6337 / 82.4774 / 87.0556
RVP,psia                     10.7012

MMT Addition,mg/l: 18
UNLEADED REGULAR,BPCD        53805
RON / MON / (R+M)/2          92.05 / 82.0489 / 87.0495
RVP,psia                     10.3834
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UNLEADED PREMIUM,BPCD          7925
RON / MON / (R+M)/2            94.9204 / 85.1315 / 90.026
RVP,psia                       9.72243

AVIATION GASOLINE,BPCD         698
RON / MON / (R+M)/2            93 / 90.8 / 91.9
RVP,psia                       10


                          STREAMS

< 0 > CRUDE FEED= 274571                   < 1 > REDUCED CRUDE= 133039
< 2 > OVERHEAD= 23634.9                    < 3 > NAPHTHA= 35981.3
< 4 > KEROSENE= 49902                      < 5 > LGO= 32013.9
< 6 > HVGO= 86169.5                        < 7 > RESIDUUM= 46869
< 8 > FCCU FEED= 88965                     < 9 > REFORMER FEED= 32600
< 10 > CAT POLY FEED= 17500                < 11 > ALKYLATION FEED= 3443.12
< 12 > LCO= 16689.8                        < 13 > HCO= 4172.46
< 14 > CRACKED GAS= 46168.4                < 15 > POLYMER= 7037.41
< 16 > LE FROM POLY (FOE)= 5628.85         < 17 > REFORMATE= 27254.7
< 18 > LE FROM CAT CRACKER (FOE)= 7806.95  < 19 > FUEL GAS (FOE)= 15377.7
< 20 > I-C4 FR. GAS PLANT= 1050.52         < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 26456               < 23 > UNLEADED REGULAR= 52805
< 24 > UNLEADED PREMIUM= 7925              < 25 > AVIATION GASOLINE= 698
< 26 > REFORMATE= 9705.71                  < 27 > NAPHTHA SPECIALTIES= 17549
< 28 > LSR= 18580.1                        < 29 > LSR+ISO= 18185.8
< 30 > LSR= 394.35                         < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 133039               < 33 > VAC RESID TO ASPHALT PLANT= 15473
< 34 > VAC RESIDUUM= 31396                 < 35 > LCO= 10000
< 36 > HVGO TO LUBE OIL= 3774              < 37 > HVGO= 0
< 38 > LCO= 6689.83                        < 39 > C3/C4 -FCCU= 19892.6
< 40 > LGO= 12784.9                        < 41 > LGO= 10332.5
< 42 > JET FUEL B= 3585                    < 43 > JET FUEL A= 11133
< 44 > STOVE OIL= 1384                     < 45 > LIGHT FUEL OIL= 20505
< 46 > DIESEL FUEL= 36545                  < 47 > HEAVY FUEL OIL= 55901
< 48 > RESID TO COKING= 0                  < 49 > REF C4 TO BLENDING = 5355.82
< 50 > ALKYLATE= 2430.87                   < 51 > CRUDE LIGHT ENDS= 1.84108
< 52 > TOTAL PRODUCT= 257060               < 53 > C2 % IN CRUDE FEED= .04423
< 54 > C3 % IN CRUDE FEED= .277635         < 55 > I-C4 % IN CRUDE FEED= .21544
< 56 > N-C4 % IN CRUDE FEED= 1.30377       < 57 > LE FROM REFORMER (FOE)= 4589.26
< 58 > NAPHTHA= 3381.3                     < 59 > KEROSENE= 10942.4
< 60 > KEROSENE= 38959.6                   < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 2392.6              < 63 > LE FROM ALKYL (FOE)= 322.722
< 64 > HVGO= 80068.5                       < 65 > LGO = 8896.5
< 66 > NAPHTHA PETROCHEMICAL FEED= 0       < 67 > VGO PETROCHEMICAL FEED= 2327
< 68 > IMPORTED C4= 0                      < 69 > LSR= 18185.8
```

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                              LIGHT ENDS BALANCE

                                 *** FROM ***
               CRUDE UNIT     REFORMER       CAT CRACKER    POLY           ALKYL          ISO            TOTAL
C2   ,#/HR      636.845        3196.9         25920.9        0              0              0              29754.6
C3   ,#/HR      5641.05        9089.32        18085.4        16196.5        1819.63        0              50831.9
IC4   ,#/HR     4868.33        6481.6         39798.8        37754.2        0              0              88902.9
NC4   ,#/HR     30506.8        9459.22        18012.6        15780.6        2157.52        0              75916.8
H2   ,#/HR      0              8685.37        10079.3        0              0              0              18764.7
C1   ,#/HR      0              3196.9         10747.7        0              0              0              13944.6
H2S   ,#/HR     0              0              11362.6        0              0              0              11362.6
C2=   ,#/HR     0              0              15805.4        0              0              0              15805.4
C3=   ,#/HR     0              0              33496.8        0              0              0              33496.8
C4=   ,#/HR     0              0              65651.8        0              0              0              65651.8
TOTAL  ,#/HR    41653          40109.3        248961         69731.3        3977.15        0              404432
BPCD (FOE)      3363.49        4589.26        20727.8        5628.86        322.722        0              34632.1

                                 *** TO ***
               POLY           ALKY           GAS BLEND      PC FEED        DDS            FUEL GAS       TOTAL
C2   ,#/HR      0              0              0              0              0              29754.6        29754.6
C3   ,#/HR      13309.2        1819.63        0              0              0              35703.1        50831.9
IC4   ,#/HR     34867          13412.8        18484.3        0              0              22138.8        88902.9
NC4   ,#/HR     15780.5        2157.51        26381.4        0              0              31597.3        75916.8
H2   ,#/HR      0              0              0              0              8086.64        10678          18764.7
C1   ,#/HR      0              0              0              0              0              13944.6        13944.6
H2S   ,#/HR     0              0              0              0              0              11362.6        11362.6
C2=   ,#/HR     0              0              0              0              0              15805.4        15805.4
C3=   ,#/HR     22889.8        3129.5         0              0              0              7477.47        33496.8
C4=   ,#/HR     57516.4        7863.64        123.668        0              0              148.137        65651.8
TOTAL  ,#/HR    144363         28383.1        44989.4        0              8086.64        178610         404432
BPCD (FOE)      11502.2        2266.92        3618.95        0              1866.4         15377.7        34632.1
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                           **** OVERALL MASS BALANCE ****
*** FEED ***

                           BPCD                        #/HR

CRUDE                       274571                      3.53734E+06
BUTANE                      0                           0
TOTAL                       274571                      3.53734E+06


*** PRODUCT ***

FUEL GAS (FOE)              15377.7                     178610
MOTOR GASOLINE              88884                       936118
AVIATION TURBO FUELS        14718                       172043
DISTILLATES                 58434                       731251
HEAVY FUEL OIL              55901                       836280
OTHER PRODUCTS              39123                       526392
H2 TO DESULFURIZERS (FOE)   1866.4                      8086.64
COKE (FOE)                  7925.35                     148805
TOTAL                       282229                      3.53759E+06
```

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TIME:10.24.35 DATE:TUESDAY 11984122 51
          REFINERY SIMULATION PROGRAM
         CASE:QUEBAS40 REGION:QUEBEC
          **** FEED BLEND ****
           CRUDE ORIGIN                   LV %           BPCD
             FRONTIER                     16.8           46388.3
             VENEZN                       11.65          32168.1
             ARABHV                       6.95           19190.4
             CANWSE                       27.3           75380.9
             SYNCRUDE                     16.3           45007.7
             MEXN                         11.6           32030
             CONDENSA                     9.4            25955.3
              No. NBP               LV %      S.G.       API         SULFUR WT%  BPCD       Lbs/hr FEED      Lbs/hr SULFUR
               Total                100                                           276121       3.55731E+06     64230
               Average                      .884407    28.4943       1.80558

                **** MATERIAL BALANCE ****

                          CRUDE UNIT
              No. Name           BPCD      Lbs/hr         IBP        EBP          S.G.       API           SULFUR WT%  Lbs/hr Su
                          *** FEED ***
              0   CRUDE FEED     276121    3.55731E+06    60         1460         .884407    28.4942        1.80558      64230
                          *** PRODUCT ***
              2   OVERHEAD       23749.7   221961         60         169.332      .641577    89.0502        .0403523     89.5664
              28  LSR            18666.4   180121         60         169.332      .662421    82.1104        .0498399     89.7722
              3   NAPHTHA        36381.3   392353         169.332    319.983      .740335    59.6297        .0842182     330.432
              4   KEROSENE       50005.4   602357         319.983    540          .826927    39.6155        .424667      2558.01
              5   LGO            32194.7   415021         540        660          .884944    28.3971        1.02294      4245.42
              1   REDUCED CRUDE  133790    1.92562E+06    660        1460         .988044    11.7123        2.96043      57006.6

                          VACUUM UNIT
              No. Name           BPCD      Lbs/hr         IBP        EBP          S.G.       API           SULFUR WT%  Lbs/hr Su
                          *** FEED ***
              32  REDUCED CRUDE  133790    1.92562E+06    660        1460         .988044    11.7123        2.96043      57006.6
                          *** PRODUCT ***
              6   HVGO           86658.8   1.18765E+06    660        1050         .940819    18.9009        1.9963       23709.1
              7   RESIDUUM       47130.8   737957         1050       1460         1.07487    .143829        4.51195      33296.2

                          CAT CRACKER
              No. Name           BPCD      Lbs/hr         IBP        EBP          S.G.       API           SULFUR WT%  Lbs/hr Su
                          *** FEED ***
              65  LGO            7967.25   102706         540        660          .884944    28.3971        1.02294      1050.62
              64  HVGO           80557.8   1.10404E+06    660        1050         .940819    18.9009        1.9963       22039.9
                          *** TOTAL FEED ***
              8   FCCU FEED      88525     1.20674E+06    540        1050         .93579     19.7091        1.91346      23090.5
                          *** PRODUCT ***
              12  LCO            15509.6   226125         430        650          1.00087    9.877          3.07359      6950.15
              13  HCO            3877.4    61720.8        650        745.412      1.09275    -2.01018       4.85628      2997.33
              14  CRACKED GAS    46305.6   508400                                 .753706    56.239         .214211      1089.05
              39  C3/C4 -FCCU    20371.5   168084                                 .566414    118.317        0            0
             *** PRODUCT ***
              < 18 > LE FROM CAT CRACKER (FOE)= 8133.17
              AVAILABLE C3/C4 OLEFINS= 20371.5
              CONVERSION Wt%= 76.1469     CONVERSION Vol %= 78.1
              COKE, WT% 12.8187
              COKE  ,#/HR 154768          Sulfur in Flue Gas,Lbs/hr= 1189.89
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                 CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 18500
*** PRODUCT ***
< 15 > POLYMER= 7434.02
< 16 > LE FROM POLY (FOE)= 5957.75

                 ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 2691.85
< 62 > C3/C4 TO ALKYL= 1871.52
< 20 > I-C4 FR. GAS PLANT= 820.326
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 1899.69
< 63 > LE FROM ALKYL (FOE)= 253.189

                 CATALYTIC REFORMER UNIT
 No. Name             BPCD      Lbs/hr        IBP         EBP         S.G.        API          SULFUR WT%  Lbs/hr Su
                 *** FEED ***
 9   REFORMER FEED 33000        355887        169.332     319.983     .740335     59.6297      0           0
                 *** PRODUCT ***
 17  REFORMATE     27330.4      312314                                .784469     48.8769      0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 4984.5
CONVERSION(LV%)= 82.8194   Severity (RON Clear)= 92    FEED KW= 12.0554

                 GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 23749.7
< 57 > LE FROM REFORMER (FOE)= 4984.5
< 18 > LE FROM CAT CRACKER (FOE)= 8133.17
< 16 > LE FROM POLY (FOE)= 5957.75
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 16794.1
< 20 > I-C4 FR. GAS PLANT= 820.326
< 49 > REF C4 TO BLENDING = 5395.92
< 69 > LSR= 18272.1

                 ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 18272.1
*** PRODUCT ***
< 29 > LSR+ISO= 18067.4

*** BY-PASS= 30 %   ***

                 GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 18067.4
< 26 > REFORMATE= 9781.36
< 50 > ALKYLATE= 1899.69
< 15 > POLYMER= 7434.02
< 14 > CRACKED GAS= 46305.6
< 49 > REF C4 TO BLENDING = 5395.92
< 68 > IMPORTED C4= 0
*** PRODUCT ***
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      < 22 > LEADED REGULAR= 8820
      < 23 > UNLEADED REGULAR= 71441
      < 24 > UNLEADED PREMIUM= 7925
      < 25 > AVIATION GASOLINE= 698

      *** GASOLINE COMPOSITION ***

                LR          UR           UP          AV

LSR           .699805     .166503      0           0
CRACKED GAS   .0515802    .55          .827521     0
REFORMATE     .226035     .109009      0           0
POLYMER       0           .104058      0           0
ALKYLATE      0           5.93237E-03  .1          .9786
C4            .0225801    .0644972     .0724793    .0214

                     TURBO FUEL BLENDING
      *** FEED ***
      < 30 > LSR= 394.35
      < 58 > NAPHTHA= 3381.3
      < 59 > KEROSENE= 10942.4
      *** PRODUCT ***
      < 42 > JET FUEL B= 3585
      < 43 > JET FUEL A= 11133

      *** TURBO FUEL COMPOSITION ***

                     NAPHTHA BASE  KEROSENE BASE

      LSR            .11           0
      NAPHTHA        .555          .125
      KEROSENE       .335          .875

                     DISTILLATE BLENDING
      *** FEED ***
      < 60 > KEROSENE= 39063.1
      < 40 > LGO= 13861.6
      < 38 > LCO= 5509.58
      *** PRODUCT ***
      < 44 > STOVE OIL= 1384
      < 45 > LIGHT FUEL OIL= 20505
      < 46 > DIESEL FUEL= 36545

      *** DISTILLATE COMPOSITION ***

                     STOVE OIL     DIESEL FUEL   LFO

      KEROSENE       1              .628          .718289
      LCO            0              .05           .179582
      LGO            0              .322          .102129

                     HEAVY FUEL OIL BLENDING
      *** FEED ***
      < 41 > LGO= 10365.8
      < 35 > LCO= 10000
      < 13 > HCO= 3877.4
      < 37 > HVGO= 0
      < 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 31657.8
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 55901

         OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 17549
< 36 > HVGO TO LUBE OIL= 3774
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 15473
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 0
< 67 > VGO PETROCHEMICAL FEED= 2327

                    DISTILLATE DESULFURIZATION

STREAM             TOTAL              FEED  TO  DDS                                    FINAL STREAM
                   BPCD         BPCD      Lbs/hr     SULFUR WT%         % BYPASS      SULFUR WT%
KEROSENE           50005.4      50005.4   602357      .424667           0              .0213194
LGO                24227.5      24227.4   312315     1.02294            2.01541E-04    .103246
LCO                15509.6      12407.7   180900     3.07359            19.9999        .880078
HCO                3877.4       0         0          4.85628            100           4.85628
VAC RESIDUUM       31657.8      0         0          4.51195            100           4.51195


  ***PRODUCT SLATES & SPECIFICATIONS***

               JET FUEL B    JET FUEL A    STOVE OIL     LFO          DIESEL FUEL   HFO

BPCD           3585          11133         1384          20505        36545         55901
S.G.           .760772       .816103       .826927       .864089      .854305       1.02765
ASTM 10%       206.816       333.571       382.001       392.755      397.182
ASTM 20%       225.538       359.99        395.23        415.118      423.754
ASTM 50%       282.138       425.021       440.329       472.239      496.304
ASTM 90%       470.361       499.746       502.856       579.35       606.444
RVP,psia       2.77847
Sulfur Wt %    .0579907      .0283755      .0212334      .204309      .0974398      3.19705
Flash Point,F  64.3913       127.435       144.249       150.012      152.459
Pour Point,F  -85.0671      -50.3611      -44.6618      -53.9616     -31.7991
Cetane No.                                                            43.4536
Visc @100F,cs  .799029       1.51276       1.72895       2.1952       2.4578        588.091
Visc @122F,cs  .704418       1.29508       1.46926       1.83165      2.04379       253.554
Watsons K      11.9522       11.7105       11.6542       11.2892      11.502        10.832
MeABP          291.821       412.893       435.057       468.251      488.778       919.41

               GASOLINE

LEADED REGULAR,BPCD            8820
TEL Addition,cc/IG: 1.24
RON / MON / (R+M)/2 (Clear)    84.1936 / 78.8085 / 81.5011
RON / MON / (R+M)/2            89.8229 / 83.8954 / 86.8592
RVP,psia                       13.8689

MMT Addition,mg/l: 0
UNLEADED REGULAR,BPCD          71441
RON / MON / (R+M)/2            91.8 / 82.3117 / 87.0559
RVP,psia                       10.7653
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                           **** OVERALL MASS BALANCE ****
*** FEED ***

                           BPCD                           #/HR

CRUDE                       276121                         3.55731E+06
BUTANE                      0                              0
TOTAL                       276121                         3.55731E+06


*** PRODUCT ***

FUEL GAS (FOE)              16794.1                        193785
MOTOR GASOLINE              88884                          935987
AVIATION TURBO FUELS        14718                          172081
DISTILLATES                 58434                          729562
HEAVY FUEL OIL              55901                          836826
OTHER PRODUCTS              39123                          526423
H2 TO DESULFURIZERS (FOE)   1874                           8119.59
COKE (FOE)                  8242.94                        154768
TOTAL                       283971                         3.55755E+06
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                        LIGHT ENDS BALANCE

                          *** FROM ***
               CRUDE UNIT  REFORMER    CAT CRACKER  POLY       ALKYL      ISO        TOTAL
C2   ,#/HR     640.44      3639.56     27305        0          0          0          31585
C3   ,#/HR     5672.9      10141.6     18537.1      17193.5    1430.52    473.247    53448.9
IC4   ,#/HR    4895.82     6807.28     40584.3      39908.7    0          842.123    93038.2
NC4   ,#/HR    30679       9934.51     18392.2      16702.5    1689.68    2397.95    79795.8
H2   ,#/HR     0           9410.53     10642.6      0          0          0          20053.1
C1   ,#/HR     0           3639.56     11321.6      0          0          0          14961.2
H2S   ,#/HR    0           0           11543.1      0          0          0          11543.1
C2=   ,#/HR    0           0           16649.4      0          0          0          16649.4
C3=   ,#/HR    0           0           33760.3      0          0          0          33760.3
C4=   ,#/HR    0           0           67203.6      0          0          0          67203.6
TOTAL   ,#/HR  41888.2     43573       255939       73804.7    3120.2     3713.32    422039
BPCD (FOE)     3382.48     4984.5      21369        5957.75    255.189    299.502    36246.4

                          *** TO ***
               POLY        ALKY        GAS BLEND    PC FEED    DDS        FUEL GAS   TOTAL
C2   ,#/HR     0           0           0            0          0          31585      31585
C3   ,#/HR     14140.7     1430.52     0            0          0          37877.7    53448.9
IC4   ,#/HR    36855.9     10479.7     19328.9      0          0          26373.7    93038.2
NC4   ,#/HR    16702.5     1689.68     25969.3      0          0          35434.3    79795.8
H2   ,#/HR     0           0           0            0          8119.59    11933.5    20053.1
C1   ,#/HR     0           0           0            0          0          14961.2    14961.2
H2S   ,#/HR    0           0           0            0          0          11543.1    11543.1
C2=   ,#/HR    0           0           0            0          0          16649.4    16649.4
C3=   ,#/HR    23913.8     2419.2      0            0          0          7427.28    33760.3
C4=   ,#/HR    61029.7     6173.96     0            0          0          0          67203.6
TOTAL   ,#/HR  152643      22193.1     45298.2      0          8119.59    193785     422039
BPCD (FOE)     12161.8     1772.53     3643.87      0          1874       16794.1    36246.4
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UNLEADED PREMIUM,BPCD      7925
RON / MON / (R+M)/2        94.7375 / 85.3332 / 90.0354
RVP,psia                   9.71993

AVIATION GASOLINE,BPCD     698
RON / MON / (R+M)/2        93 / 90.8 / 91.9
RVP,psia                   10
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STREAMS

```
< 0 > CRUDE FEED= 276121                      < 1 > REDUCED CRUDE= 133790
< 2 > OVERHEAD= 23749.7                       < 3 > NAPHTHA= 36381.3
< 4 > KEROSENE= 50005.4                       < 5 > LCO= 32194.7
< 6 > HVGO= 86658.8                           < 7 > RESIDUUM= 47130.8
< 8 > FCCU FEED= 80525                        < 9 > REFORMER FEED= 33000
< 10 > CAT POLY FEED= 18500                   < 11 > ALKYLATION FEED= 2691.85
< 12 > LCO= 15509.6                           < 13 > HCO= 3877.4
< 14 > CRACKED GAS= 46305.6                   < 15 > POLYMER= 7434.02
< 16 > LE FROM POLY (FOE)= 5957.75            < 17 > REFORMATE= 27330.4
< 18 > LE FROM CAT CRACKER (FOE)= 8133.17     < 19 > FUEL GAS (FOE)= 16794.1
< 20 > I-C4 FR. GAS PLANT= 820.326            < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 8820                   < 23 > UNLEADED REGULAR= 71441
< 24 > UNLEADED PREMIUM= 7925                 < 25 > AVIATION GASOLINE= 698
< 26 > REFORMATE= 9781.36                     < 27 > NAPHTHA SPECIALTIES= 17549
< 28 > LSR= 18666.4                           < 29 > LSR+ISO= 18067.4
< 30 > LSR= 394.35                            < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 133790                  < 33 > VAC RESID TO ASPHALT PLANT= 15473
< 34 > VAC RESIDUUM= 31657.8                  < 35 > LCO= 10000
< 36 > HVGO TO LUBE OIL= 3774                 < 37 > HVGO= 0
< 38 > LCO= 5509.58                           < 39 > C3/C4 -FCCU= 20371.5
< 40 > LGO= 13861.6                           < 41 > LGO= 10365.8
< 42 > JET FUEL B= 3585                       < 43 > JET FUEL A= 11133
< 44 > STOVE OIL= 1384                        < 45 > LIGHT FUEL OIL= 20505
< 46 > DIESEL FUEL= 36545                     < 47 > HEAVY FUEL OIL= 55901
< 48 > RESID TO COKING= 0                     < 49 > REF C4 TO BLENDING = 5395.92
< 50 > ALKYLATE= 1899.69                      < 51 > CRUDE LIGHT ENDS= 1.84108
< 52 > TOTAL PRODUCT= 257060                  < 53 > C2 % IN CRUDE FEED= .04423
< 54 > C3 % IN CRUDE FEED= .277635            < 55 > I-C4 % IN CRUDE FEED= .21544
< 56 > N-C4 % IN CRUDE FEED= 1.30377          < 57 > LE FROM REFORMER (FOE)= 4984.5
< 58 > NAPHTHA= 3381.3                        < 59 > KEROSENE= 10942.4
< 60 > KEROSENE= 39063.1                      < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 1871.52                < 63 > LE FROM ALKYL (FOE)= 253.189
< 64 > HVGO= 80557.8                          < 65 > LGO = 7967.25
< 66 > NAPHTHA PETROCHEMICAL FEED= 0          < 67 > VGO PETROCHEMICAL FEED= 2327
< 68 > IMPORTED C4= 0                         < 69 > LSR= 18272.1
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TIME:15.41.52 DATE:MONAPR301984121 40
          REFINERY SIMULATION PROGRAM
         CASE:ONTBAS41 REGION:ONTARIO
          **** FEED BLEND ****
            CRUDE ORIGIN              LV %         BPCD
             CANBNL                   45           217790
             CANBUN                   9.2          40891.3
             SYNCRUDE                 30.8         136897
             CONDENSA                 11           48891.7
              No. NBP            LV %      S.G.         API           SULFUR WT%  BPCD        Lbs/hr FEED      Lbs/hr SULFUR
               Total             100                                               444470        5.445E+06         26263.7
               Average                     .84098       36.7562       .482344

               **** MATERIAL BALANCE ****

                          CRUDE UNIT
              No. Name          BPCD        Lbs/hr        IBP          EBP          S.G.        API          SULFUR WT%  Lbs/hr Su
                          *** FEED ***
              0   CRUDE FEED    444470      5.445E+06     60           1300         .840979     36.7562       .482345     26263.7
                          *** PRODUCT ***
              2   OVERHEAD      53850.2     502986        60           169.861      .641207     89.1775       .028942     145.574
              28  LSR           40581.8     395079        60           169.861      .668317     80.2259       .0368261    145.492
              3   NAPHTHA       81358.1     892418        169.861      320.673      .753004     56.414        .0267851    239.035
              4   KEROSENE      107914      1.31017E+06   320.673      560          .833448     38.2767       .10658      1396.38
              5   LGO           47815.2     615177        560          660          .88321      28.711        .312237     1920.81
              1   REDUCED CRUDE 153533      2.12425E+06   660          1300         .949805     17.478        1.06211     22561.9

                          VACUUM UNIT
              No. Name          BPCD        Lbs/hr        IBP          EBP          S.G.        API          SULFUR WT%  Lbs/hr Su
                          *** FEED ***
              32  REDUCED CRUDE 153533      2.12425E+06   660          1300         .949805     17.478        1.06211     22561.9
                          *** PRODUCT ***
              6   HVGO          123025      1.65431E+06   660          1050         .923111     21.786        .618341     10229.3
              7   RESIDUUM      30507.8     469943        1050         1300        1.05746      2.31122       2.62443     12333.3

                          CAT CRACKER
              No. Name          BPCD        Lbs/hr        IBP          EBP          S.G.        API          SULFUR WT%  Lbs/hr Su
                          *** FEED ***
              65  LGO           28931.7     372227        560          660          .88321      28.711        .312237     1162.23
              64  HVGO          96858.3     1.30245E+06   660          1050         .923111     21.786        .618341     8053.58
                          *** TOTAL FEED ***
              8   FCCU FEED     125790      1.67468E+06   560          1050         .913934     23.3252       .550304     9215.81
                          *** PRODUCT ***
              12  LCO           20327.7     285661        430          650          .964702     15.1774       .945391     2700.62
              13  HCO           5081.92     79730.7       650          737.274     1.07703     -.120178       1.49372     1190.95
              14  CRACKED GAS   71632.4     781925                                  .749351     57.3301       .0543852    425.251
              39  C3/C4 -FCCU   20025.9     164398                                  .563553     119.586       0           0
             *** PRODUCT ***
             < 18 > LE FROM CAT CRACKER (FOE)= 18393.9
             AVAILABLE C3/C4 OLEFINS= 31246.3
             CONVERSION Wt%= 78.1814     CONVERSION Vol %= 79.8
             COKE, WT% 9.60159
             COKE  ,#/HR 160878          Sulfur in Flue Gas,Lbs/hr= 490.828

                          CAT POLY UNIT
             *** FEED ***
```

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< 10 > CAT POLY FEED= 1E-06
*** PRODUCT ***
< 15 > POLYMER= 4.08483E-07
< 16 > LE FROM POLY (FOE)= 3.12951E-07

                 ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 29000
< 62 > C3/C4 TO ALKYL= 20025.9
< 20 > I-C4 FR. GAS PLANT= 5502.85
< 21 > I-C4 IMPORTED= 3471.21
*** PRODUCT ***
< 50 > ALKYLATE= 20735.9
< 63 > LE FROM ALKYL (FOE)= 2440.82

                 CATALYTIC REFORMER UNIT
 No. Name             BPCD        Lbs/hr         IBP          EBP          S.G.         API          SULFUR WT%  Lbs/hr Su
                 *** FEED ***
 9   REFORMER FEED 61250      671852         169.861      320.673      .753004   56.414           0            0
                 *** PRODUCT ***
 17  REFORMATE      51918.2    604592                                   .799416   45.5043          0            0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 7715.26
CONVERSION(LV%)= 84.7644    Severity (RON Clear)= 93.3  FEED KW= 11.8548

                 GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 53850.2
< 57 > LE FROM REFORMER (FOE)= 7715.26
< 18 > LE FROM CAT CRACKER (FOE)= 18393.9
< 16 > LE FROM POLY (FOE)= 3.12951E-07
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 24944.7
< 20 > I-C4 FR. GAS PLANT= 5502.85
< 49 > REF C4 TO BLENDING = 8894.15
< 69 > LSR= 40111.3

                 ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 40111.3
*** PRODUCT ***
< 29 > LSR+ISO= 40111.3

*** BY-PASS= 100 %   ***

                 GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 40111.3
< 26 > REFORMATE= 29337.2
< 50 > ALKYLATE= 20735.9
< 15 > POLYMER= 4.08483E-07
< 14 > CRACKED GAS= 71632.4
< 49 > REF C4 TO BLENDING = 8894.15
< 68 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 51175
< 23 > UNLEADED REGULAR= 104062
< 24 > UNLEADED PREMIUM= 15348
```

```
     < 25 > AVIATION GASOLINE= 126

     *** GASOLINE COMPOSITION ***

                  LR            UR            UP            AV

LSR           .425467       .176595       0             0
CRACKED GAS   .383028       .5            0             0
REFORMATE     .147106       .100616       .738776       0
POLYMER       0             3.92538E-12   0             0
ALKYLATE      0             .168582       .2            .9786
C4            .0443994      .0542072      .0612241      .0214

                  TURBO FUEL BLENDING
     *** FEED ***
     < 30 > LSR= 470.47
     < 58 > NAPHTHA= 4823.08
     < 59 > KEROSENE= 18608.5
     *** PRODUCT ***
     < 42 > JET FUEL B= 4277
     < 43 > JET FUEL A= 19625

     *** TURBO FUEL COMPOSITION ***

                  NAPHTHA BASE  KEROSENE BASE

     LSR           .11           0
     NAPHTHA       .6            .115
     KEROSENE      .29           .885

                  DISTILLATE BLENDING
     *** FEED ***
     < 60 > KEROSENE= 89305.1
     < 40 > LGO= 18883.3
     < 38 > LCO= 14277.7
     *** PRODUCT ***
     < 44 > STOVE OIL= 2264
     < 45 > LIGHT FUEL OIL= 38243
     < 46 > DIESEL FUEL= 81959

     *** DISTILLATE COMPOSITION ***

                  STOVE OIL     DIESEL FUEL   LFO

     KEROSENE      1             .64           .904409
     LCO           0             .14           .0733049
     LGO           0             .22           .022286

                  HEAVY FUEL OIL BLENDING
     *** FEED ***
     < 41 > LGO= .249023
     < 35 > LCO= 6050
     < 13 > HCO= 5081.92
     < 37 > HVGO= 0
     < 31 > REDUCED CRUDE= 0
     < 34 > VAC RESIDUUM= 22141.8
     *** PRODUCT ***
     < 47 > HEAVY FUEL OIL= 33274
```

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                 OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES- 22581
< 36 > HVGO TO LUBE OIL- 10882
< 48 > RESID TO COKING- 0
< 33 > VAC RESID TO ASPHALT PLANT- 8366
< 61 > OLEFIN PETROCHEMICAL FEED- 0
< 66 > NAPHTHA PETROCHEMICAL FEED- 15285
< 67 > VGO PETROCHEMICAL FEED- 15285

                         DISTILLATE DESULFURIZATION

STREAM              TOTAL                FEED  TO  DDS                                    FINAL STREAM
                    BPCD        BPCD       Lbs/hr        SULFUR WT%          % BYPASS     SULFUR WT%
KEROSENE            107914      107914     1.31017E+06   .10658              0            5.3364E-03
LGO                 18883.5     18883.5    242950        .312237             0            .0313117
LCO                 20327.7     18294.9    257095        .945391             10.0001      .181012
HCO                 5081.92     0          0             1.49372             100          1.49372
VAC RESIDUUM        22141.8     0          0             2.62443             100          2.62443


    ***PRODUCT SLATES & SPECIFICATIONS***

                 JET FUEL B   JET FUEL A    STOVE OIL     LFO          DIESEL FUEL   HFO

BPCD             4277         19625         2264          38243        81959         33274
S.G.             .767017      .824197       .833448       .844178      .862771       1.04358
ASTM 10%         206.631      344.29        383.696       386.959      397.856
ASTM 20%         224.146      367.732       398.672       404.374      425.724
ASTM 50%         274.405      432.07        447.59        458.301      498.08
ASTM 90%         470.583      516.868       519.47        530.639      603.648
RVP,psia         2.41517
Sulfur Wt %      .0209863     7.58334E-03   5.32902E-03   .0205336     .038445       2.03526
Flash Point,F    64.3346      133.39        144.02        145.72       151.584
Pour Point,F     -95.6461     -50.4106      -44.8521      -48.2866     -38.8401
Cetane No.                                                             40.4687
Visc @100F,cs    .776442      1.61175       1.8213        1.93572      2.48786       1667.56
Visc @122F,cs    .684835      1.37441       1.54243       1.63154      2.06346       592.884
Watsons K        11.8184      11.6401       11.5969       11.4849      11.3892       10.7665
MeABP            284.886      423.002       442.955       451.344      488.793       958.49

                 GASOLINE

LEADED REGULAR,BPCD                51175
TEL Addition,cc/IG: 1.26
RON / MON / (R+M)/2 (Clear)        85.9773 / 78.3983 / 82.188
RON / MON / (R+M)/2                91.2613 / 83.0774 / 87.1694
RVP,psia                           11.1268

MMT Addition,mg/1: 18
UNLEADED REGULAR,BPCD              104062
RON / MON / (R+M)/2                90.85 / 83.1875 / 87.0188
RVP,psia                           10.3605

UNLEADED PREMIUM,BPCD              15348
RON / MON / (R+M)/2                94.2114 / 85.956 / 90.0837
RVP,psia                           9.74662
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AVIATION GASOLINE,BPCD        126
RON / MON / (R+M)/2           93 / 90.8 / 91.9
RVP,psia                      10
```

STREAMS

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< 0 > CRUDE FEED= 444470                        < 1 > REDUCED CRUDE= 153533
< 2 > OVERHEAD= 53850.2                         < 3 > NAPHTHA= 81358.1
< 4 > KEROSENE= 107914                          < 5 > LGO= 47815.2
< 6 > HVGO= 123025                              < 7 > RESIDUUM= 30507.8
< 8 > FCCU FEED= 125790                         < 9 > REFORMER FEED= 61250
< 10 > CAT POLY FEED= 1E-06                     < 11 > ALKYLATION FEED= 29000
< 12 > LCO= 20327.7                             < 13 > HCO= 5081.92
< 14 > CRACKED GAS= 71632.4                     < 15 > POLYMER= 4.08483E-07
< 16 > LE FROM POLY (FOE)= 3.12951E-07          < 17 > REFORMATE= 51918.2
< 18 > LE FROM CAT CRACKER (FOE)= 18393.9       < 19 > FUEL GAS (FOE)= 24944.7
< 20 > I-C4 FR. GAS PLANT= 5502.85              < 21 > I-C4 IMPORTED= 3471.21
< 22 > LEADED REGULAR= 51175                    < 23 > UNLEADED REGULAR= 104062
< 24 > UNLEADED PREMIUM= 15348                  < 25 > AVIATION GASOLINE= 126
< 26 > REFORMATE= 29337.2                       < 27 > NAPHTHA SPECIALTIES= 22581
< 28 > LSR= 40581.8                             < 29 > LSR+ISO= 40111.3
< 30 > LSR= 470.47                              < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 153533                    < 33 > VAC RESID TO ASPHALT PLANT= 8366
< 34 > VAC RESIDUUM= 22141.8                    < 35 > LCO= 6050
< 36 > HVGO TO LUBE OIL= 10882                  < 37 > HVGO= 0
< 38 > LCO= 14277.7                             < 39 > C3/C4 -FCCU= 20025.9
< 40 > LGO= 18883.3                             < 41 > LGO= .249023
< 42 > JET FUEL B= 4277                         < 43 > JET FUEL A= 19625
< 44 > STOVE OIL= 2264                          < 45 > LIGHT FUEL OIL= 38243
< 46 > DIESEL FUEL= 81959                       < 47 > HEAVY FUEL OIL= 33274
< 48 > RESID TO COKING= 0                       < 49 > REF C4 TO BLENDING = 8894.15
< 50 > ALKYLATE= 20735.9                        < 51 > CRUDE LIGHT ENDS= 2.98522
< 52 > TOTAL PRODUCT= 422752                    < 53 > C2 % IN CRUDE FEED= .08668
< 54 > C3 % IN CRUDE FEED= .69156               < 55 > I-C4 % IN CRUDE FEED= .36344
< 56 > N-C4 % IN CRUDE FEED= 1.84354            < 57 > LE FROM REFORMER (FOE)= 7715.26
< 58 > NAPHTHA= 4823.08                         < 59 > KEROSENE= 18608.5
< 60 > KEROSENE= 89305.1                        < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 20025.9                  < 63 > LE FROM ALKYL (FOE)= 2440.82
< 64 > HVGO= 96858.3                            < 65 > LGO = 28931.7
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285        < 67 > VGO PETROCHEMICAL FEED= 15285
< 68 > IMPORTED C4= 0                           < 69 > LSR= 40111.3
```

LIGHT ENDS BALANCE

```
                              *** FROM ***
             CRUDE UNIT   REFORMER    CAT CRACKER   POLY          ALKYL       ISO        TOTAL
C2   ,#/HR    2020.34     4791.5       35808.5      0             0           0           42620.3
C3   ,#/HR    22746       14883.3      27183.9      0             14634.7     0           79447.9
IC4   ,#/HR   13294.6     11402.8      63979.5      0             0           0           88676.9
NC4   ,#/HR   69829.2     16641.2      24077.1      0             15431.1     0           125979
H2   ,#/HR    0           14749.5      14571.9      0             0           0           29321.4
C1   ,#/HR    0           4791.5       14847.4      0             0           0           19638.9
H2S   ,#/HR   0           0            4683.67      0             0           0           4683.67
C2=   ,#/HR   0           0            21834.4      0             0           0           21834.4
C3=   ,#/HR   0           0            64312        0             0           0           64312
C4=   ,#/HR   0           0            95456.9      0             0           0           95454.9
TOTAL   ,#/HR 107890      67259.8      366753       3.8773E-06    30065.8     0           571969
BPCD (FOE)    8724.16     7715.27      31430.4      3.12951E-07   2440.82     0           50310.6

                              *** TO ***
             POLY          ALKY        GAS BLEND    PC FEED       HDS         FUEL GAS    TOTAL
C2   ,#/HR    0            0            0            0            0            42620.3     42620.3
C3   ,#/HR    0            14634.7      0            0            0            64813.2     79447.9
IC4   ,#/HR   0            86293.2      1233.3       0            0            1150.37     88676.9
NC4   ,#/HR   0            15431.1      57198.1      0            0            53349.4     125979
H2   ,#/HR    0            0            0            0            10958.6      18362.8     29321.4
C1   ,#/HR    0            0            0            0            0            19638.9     19638.9
H2S   ,#/HR   0            0            0            0            0            4683.67     4683.67
C2=   ,#/HR   0            0            0            0            0            21834.4     21834.4
C3=   ,#/HR   0            32149.9      0            0            0            32162.1     64312
C4=   ,#/HR   0            61177.5      17735.4      0            0            16542       95454.9
TOTAL   ,#/HR 8.20927E-06  209686       76166.8      0            10958.6      275157      571969
BPCD (FOE)    6.54135E-07  16736.8      6099.96      0            2529.24      24944.7     50310.6
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                         **** OVERALL MASS BALANCE ****
*** FEED ***

                         BPCD                     #/HR

CRUDE                     444470                   5.445E+06
BUTANE                    3471.21                  28568.1
TOTAL                     447941                   5.47357E+06


*** PRODUCT ***

FUEL GAS (FOE)            24944.7                  275157
MOTOR GASOLINE            170711                   1.79841E+06
AVIATION TURBO FUELS      23902                    283407
DISTILLATES               122466                   1.52783E+06
HEAVY FUEL OIL            33274                    505826
OTHER PRODUCTS            72399                    911356
H2 TO DESULFURIZERS (FOE) 2529.24                  10958.6
COKE (FOE)                8568.36                  160878
TOTAL                     458794                   5.47382E+06
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TIME:16.43.26 DATE:MONAPR301984121 40
        REFINERY SIMULATION PROGRAM
        CASE:ONTBAS40 REGION:ONTARIO
         **** FEED BLEND ****
          CRUDE ORIGIN                LV %          BPCD
           [illegible]                49            218653
           [illegible]                9.2           41053.3
           SYNCRUDE                   30.8          137439
           CONDENSA                   11            49085.4
            No. NBP            LV %      S.G.       API          SULFUR WT%  BPCD        Lbs/hr FEED     Lbs/hr SULFUR
             Total             100                                           446231        5.46658E+06   26367.7
             Average                   .840979    36.7563      .482344

           **** MATERIAL BALANCE ****

                        CRUDE UNIT
            No. Name          BPCD         Lbs/hr        IBP         EBP         S.G.       API          SULFUR WT%  Lbs/hr Su
                        *** FEED ***
            0   CRUDE FEED    446231       5.46658E+06   60          1300        .840981    36.756        .482344     26367.7
                        *** PRODUCT ***
            2   OVERHEAD      54351.7      508007        60          170.44      .641632    89.0314       .0289343    146.988
            28  LSR           41030.7      399652        60          170.44      .668656    80.1185       .0367609    146.916
            3   NAPHTHA       81858.1      898292        170.44      321.569     .753331    56.3324       .0268373    241.077
            4   KEROSENE      107875       1.31E+06      321.569     560         .833644    38.2367       .106867     1399.96
            5   LGO           48004.7      617615        560         660         .88321     28.711        .312237     1928.42
            1   REDUCED CRUDE 154141       2.13267E+06   660         1300        .949805    17.478        1.06211     22651.3

                        VACUUM UNIT
            No. Name          BPCD         Lbs/hr        IBP         EBP         S.G.       API          SULFUR WT%  Lbs/hr Su
                        *** FEED ***
            32  REDUCED CRUDE 154141       2.13267E+06   660         1300        .949805    17.478        1.06211     22651.3
                        *** PRODUCT ***
            6   HVGO          123514       1.66089E+06   660         1050        .923111    21.786        .618341     10269.9
            7   RESIDUUM      30627.2      471782        1050        1300        1.05746    2.31122       2.62443     12381.6

                        CAT CRACKER
            No. Name          BPCD         Lbs/hr        IBP         EBP         S.G.       API          SULFUR WT%  Lbs/hr Su
                        *** FEED ***
            65  LGO           29077.7      374106        560         660         .88321     28.711        .312237     1168.1
            64  HVGO          97347.3      1.30903E+06   660         1050        .923111    21.786        .618341     8094.24
                        *** TOTAL FEED ***
            8   FCCU FEED     126425       1.68313E+06   560         1050        .913934    23.3252       .550304     9262.33
                        *** PRODUCT ***
            12  LCO           20228        284333        430         650         .964948    15.14         .952249     2707.56
            13  HCO           5057         79381.7       650         736.438     1.0776     -.189667      1.50455     1194.34
            14  CRACKED GAS   72125.5      787470                                .749506    57.291        .0541336    426.286
            39  C3/C4 -FCCU   20026.6      164405                                .563555    119.585       0           0
           *** PRODUCT ***
           < 18 > LE FROM CAT CRACKER (FOE)= 18680.6
           AVAILABLE C3/C4 OLEFINS= 31507.8
           CONVERSION Wt%= 78.3906      CONVERSION Vol %= 80
           COKE, WT% 9.63115
           COKE  ,#/HR 162188           Sulfur in Flue Gas,Lbs/hr= 495.217

                        CAT POLY UNIT
           *** FEED ***
```

```
< 10 > CAT POLY FEED= 1E-06
*** PRODUCT ***
< 15 > POLYMER= 4.08466E-07
< 16 > LE FROM POLY (FOE)= 3.12969E-07

               ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 29000
< 62 > C3/C4 TO ALKYL= 20026.6
< 20 > I-C4 FR. GAS PLANT= 5909.61
< 21 > I-C4 IMPORTED= 3063.83
*** PRODUCT ***
< 50 > ALKYLATE= 20735.6
< 63 > LE FROM ALKYL (FOE)= 2441.19

               CATALYTIC REFORMER UNIT
No. Name            BPCD     Lbs/hr        IBP        EBP        S.G.       API         SULFUR WT%  Lbs/hr Su
               *** FEED ***
 9  REFORMER FEED 61750      677630        170.44     321.569    .753331   56.3324        0           0
               *** PRODUCT ***
 17  REFORMATE      51428.4  598474                              .798863   45.6267        0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 9072.39
CONVERSION(LV%)= 83.2849    Severity (RON Clear)= 95    FEED KW= 11.8534

               GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 54351.7
< 57 > LE FROM REFORMER (FOE)= 9072.39
< 18 > LE FROM CAT CRACKER (FOE)= 18690.6
< 16 > LE FROM POLY (FOE)= 3.12969E-07
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 27018.6
< 20 > I-C4 FR. GAS PLANT= 5909.61
< 49 > REF C4 TO BLENDING = 8896.63
< 69 > LSR= 40560.2

               ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 40560.2
*** PRODUCT ***
< 29 > LSR+ISO= 40105.9

*** BY-PASS= 30 %   ***

               GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 40105.9
< 26 > REFORMATE= 28847.4
< 50 > ALKYLATE= 20735.6
< 15 > POLYMER= 4.08466E-07
< 14 > CRACKED GAS= 72125.5
< 49 > REF C4 TO BLENDING = 8896.63
< 68 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 17058
< 23 > UNLEADED REGULAR= 138179
< 24 > UNLEADED PREMIUM= 15348
< 25 > AVIATION GASOLINE- 126

*** GASOLINE COMPOSITION ***

              LR          UR            UP          AV

LSR          .367437     .245099       0           0
CRACKED GAS  .583008     .45           0           0
REFORMATE    0           .116273       .832739     0
POLYMER      0           2.95606E-12   0           0
ALKYLATE     0           .138063       .1          .9786
C4           .0495557    .0505646      .0672607    .0214

              TURBO FUEL BLENDING
    *** FEED ***
    < 30 > LSR- 470.47
    < 58 > NAPHTHA- 4823.08
    < 59 > KEROSENE- 18608.5
    *** PRODUCT ***
    < 42 > JET FUEL B- 4277
    < 43 > JET FUEL A- 19625

    *** TURBO FUEL COMPOSITION ***

              NAPHTHA BASE  KEROSENE BASE

    LSR        .11           0
    NAPHTHA    .6            .115
    KEROSENE   .29           .885

              DISTILLATE BLENDING
    *** FEED ***
    < 60 > KEROSENE- 89266.9
    < 40 > LCO- 18926.1
    < 38 > LCO- 14273
    *** PRODUCT ***
    < 44 > STOVE OIL- 2264
    < 45 > LIGHT FUEL OIL- 38243
    < 46 > DIESEL FUEL- 81959

    *** DISTILLATE COMPOSITION ***

              STOVE OIL     DIESEL FUEL   LFO

    KEROSENE   1             .64           .90341
    LCO        0             .14           .0731831
    LCO        0             .22           .023407

              HEAVY FUEL OIL BLENDING
    *** FEED ***
    < 41 > LCO- .789063
    < 35 > LCO- 5955
    < 13 > HCO- 5057
    < 37 > HVGO- 0
    < 31 > REDUCED CRUDE- 0
    < 34 > VAC RESIDUUM- 22261.2
    *** PRODUCT ***
    < 47 > HEAVY FUEL OIL- 33274
```

```
              OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 22581
< 36 > HVGO TO LUBE OIL= 10882
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 8366
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285
< 67 > VGO PETROCHEMICAL FEED= 15285

                          DISTILLATE DESULFURIZATION

STREAM              TOTAL                FEED  TO  DDS                              FINAL STREAM
                    BPCD        BPCD        Lbs/hr     SULFUR WTZ        Z BYPASS      SULFUR WTZ
KEROSENE            107875      107875      1.31E+06   .106867           0             5.34878E-03
LGO                 10927       10926.9     243508     .312237           5.26282E-04   .0313132
LCO                 20228       18205.2     255900     .952249           10            .182334
HCO                 5057        0           0          1.50455           100           1.50455
VAC RESIDUUM        22261.2     0           0          2.62443           100           2.62443


   ***PRODUCT SLATES & SPECIFICATIONS***

                 JET FUEL B   JET FUEL A    STOVE OIL     LFO          DIESEL FUEL   HFO

BPCD              4277         19625         2264          38243        81959         33274
S.G.              .767308      .824408       .833644       .844413      .862931       1.04396
ASTM 10Z          206.981      345.107       384.615       387.913      398.792
ASTM 20Z          224.638      368.561       399.503       405.252      426.436
ASTM 50Z          275.127      432.646       448.116       458.877      498.303
ASTM 90Z          470.995      516.957       519.565       530.906      603.637
RVP,psia          2.76616
Sulfur Wt Z       .0210164     7.60205E-03   5.34336E-03   .020661      .0386587      2.04448
Flash Point,F     64.5267      133.847       144.51        146.229      152.087
Pour Point,F     -95.4851     -50.2025      -44.6415      -48.0537     -38.7127
Cetane No.                                                              40.4425
Visc @100F,cs     .778646      1.61725       1.82758       1.94354      2.49454       1759.68
Visc @122F,cs     .686702      1.37886       1.54746       1.63775      2.06864       619.625
Watsons K         11.817       11.6396       11.5966       11.4844      11.3887       10.7678
MeABP             285.484      423.579       443.518       451.985      489.184       960.56

                 GASOLINE

LEADED REGULAR,BPCD             17058
TEL Addition,cc/IG: 1.24
RON / MON / (R+M)/2 (Clear)     89.7419 / 81.9945 / 85.8682
RON / MON / (R+M)/2             94.4449 / 86.0918 / 90.2684
RVP,psia                        11.9713

MMT Addition,mg/l: 0
UNLEADED REGULAR,BPCD           138179
RON / MON / (R+M)/2             90.688 / 83.3986 / 87.0433
RVP,psia                        11.2279

UNLEADED PREMIUM,BPCD           15348
RON / MON / (R+M)/2             94.4391 / 85.5919 / 90.0155
RVP,psia                        9.73702
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AVIATION GASOLINE,BPCD        126
RON / MON / (R+M)/2           93 / 90.8 / 91.9
RVP,psia                      10
```

STREAMS

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< 0 > CRUDE FEED= 446231                              < 1 > REDUCED CRUDE= 154141
< 2 > OVERHEAD= 54351.7                               < 3 > NAPHTHA= 81858.1
< 4 > KEROSENE= 107875                                < 5 > LGO= 48004.7
< 6 > HVGO= 123514                                    < 7 > RESIDUUM= 30627.2
< 8 > FCCU FEED= 126425                               < 9 > REFORMER FEED= 61750
< 10 > CAT POLY FEED= 1E-06                           < 11 > ALKYLATION FEED= 29000
< 12 > LCO= 20228                                     < 13 > HCO= 5057
< 14 > CRACKED GAS= 72125.5                           < 15 > POLYMER= 4.08466E-07
< 16 > LE FROM POLY (FOE)= 3.12969E-07                < 17 > REFORMATE= 51428.4
< 18 > LE FROM CAT CRACKER (FOE)= 18680.6             < 19 > FUEL GAS (FOE)= 27018.6
< 20 > I-C4 FR. GAS PLANT= 5909.61                    < 21 > I-C4 IMPORTED= 3063.83
< 22 > LEADED REGULAR= 17058                          < 23 > UNLEADED REGULAR= 138179
< 24 > UNLEADED PREMIUM= 15348                        < 25 > AVIATION GASOLINE= 126
< 26 > REFORMATE= 28847.4                             < 27 > NAPHTHA SPECIALTIES= 22581
< 28 > LSR= 41030.7                                   < 29 > LSR+ISO= 40105.9
< 30 > LSR= 470.47                                    < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 154141                          < 33 > VAC RESID TO ASPHALT PLANT= 8366
< 34 > VAC RESIDUUM= 22261.2                          < 35 > LCO= 5955
< 36 > HVGO TO LUBE OIL= 10882                        < 37 > HVGO= 0
< 38 > LCO= 14273                                     < 39 > C3/C4 -FCCU= 20026.6
< 40 > LGO= 18926.1                                   < 41 > LGO= .789063
< 42 > JET FUEL B= 4277                               < 43 > JET FUEL A= 19625
< 44 > STOVE OIL= 2264                                < 45 > LIGHT FUEL OIL= 38243
< 46 > DIESEL FUEL= 81959                             < 47 > HEAVY FUEL OIL= 33274
< 48 > RESID TO COKING= 0                             < 49 > REF C4 TO BLENDING = 8896.63
< 50 > ALKYLATE= 20735.6                              < 51 > CRUDE LIGHT ENDS= 2.98522
< 52 > TOTAL PRODUCT= 422752                          < 53 > C2 % IN CRUDE FEED= .08668
< 54 > C3 % IN CRUDE FEED= .69156                     < 55 > I-C4 % IN CRUDE FEED= .36344
< 56 > N-C4 % IN CRUDE FEED= 1.84354                  < 57 > LE FROM REFORMER (FOE)= 9072.39
< 58 > NAPHTHA= 4823.08                               < 59 > KEROSENE= 18608.5
< 60 > KEROSENE= 89266.5                              < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 20026.6                        < 63 > LE FROM ALKYL (FOE)= 2441.19
< 64 > HVGO= 97347.3                                  < 65 > LGO = 29077.7
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285              < 67 > VGO PETROCHEMICAL FEED= 15285
< 68 > IMPORTED C4= 0                                 < 69 > LSR= 40560.2
```

LIGHT ENDS BALANCE

```
                                  *** FROM ***
              CRUDE UNIT    REFORMER      CAT CRACKER   POLY          ALKYL         ISO           TOTAL
C2   ,#/HR     2028.34       6527.92       36197.3       0             0             0             44753.6
C3   ,#/HR     22836.1       18211.2       27420.8       0             14640.2       1050.51       84158.8
IC4   ,#/HR    13347.3       12469.9       64516.4       0             0             1869.34       92202.9
NC4   ,#/HR    70105.8       18198.6       24276.2       0             15430.1       5322.96       133334
H2   ,#/HR     0             17220.7       14731.2       0             0             0             31951.9
C1   ,#/HR     0             6527.92       15008.6       0             0             0             21536.5
H2S   ,#/HR    0             0             4716.37       0             0             0             4716.37
C2=   ,#/HR    0             0             22071.5       0             0             0             22071.5
C3=   ,#/HR    0             0             64825.5       0             0             0             64825.5
C4=   ,#/HR    0             0             96267.2       0             0             0             96267.2
TOTAL   ,#/HR  108318        79156.2       370031        3.87753E-06   30070.3       8242.81       595818
BPCD (FOE)     8758.72       9072.39       31717.1       3.12969E-07   2441.19       664.833       52654.3

                                  *** TO ***
              POLY          ALKY          GAS BLEND     PC FEED       DDS           FUEL GAS      TOTAL
C2   ,#/HR     0             0             0             0             0             44753.6       44753.6
C3   ,#/HR     0             14640.3       0             0             0             69518.6       84158.8
IC4   ,#/HR    0             89643.2       1253.61       0             0             1306.11       92202.9
NC4   ,#/HR    0             15430.1       57741.2       0             0             60162.3       133334
H2   ,#/HR     0             0             0             0             10953         20998.9       31951.9
C1   ,#/HR     0             0             0             0             0             21536.5       21536.5
H2S   ,#/HR    0             0             0             0             0             4716.37       4716.37
C2=   ,#/HR    0             0             0             0             0             22071.5       22071.5
C3=   ,#/HR    0             32138.8       0             0             0             32686.7       64825.5
C4=   ,#/HR    0             61188.2       17179.4       0             0             17899.6       96267.2
TOTAL   ,#/HR  8.20931E-06   213041        76174.2       0             10953         295650        595818
BPCD (FOE)     6.54138E-07   17006.1       6101.63       0             2527.96       27018.6       52654.3
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                              **** OVERALL MASS BALANCE ****
*** FEED ***

                              BPCD                      #/HR

CRUDE                         446231                    5.46658E+06
BUTANE                        3063.83                   25215.3
TOTAL                         449295                    5.4918E+06


*** PRODUCT ***

FUEL GAS (FOE)                27018.6                   295650
MOTOR GASOLINE                170711                    1.79435E+06
AVIATION TURBO FUELS          23902                     283485
DISTILLATES                   122466                    1.52815E+06
HEAVY FUEL OIL                33274                     506010
OTHER PRODUCTS                72399                     911247
H2 TO DESULFURIZERS (FOE)     2527.96                   10953
COKE (FOE)                    8638.13                   162188
TOTAL                         460937                    5.49204E+06
```

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TIME:14.34.13 DATE:MONAPR301984121 40
          R E F I N E R Y  S I M U L A T I O N  P R O G R A M
          CASE:WESBAS41 REGION:WESTERN
           **** FEED BLEND ****
            CRUDE ORIGIN             LV %          BPCD
             CANMNL                  65.1          319677
             SYNCRUDE                31.5          154683
             CONDENSA                3.4           16695.9
              No.  MBP           LV %      S.G.        API          SULFUR WT%  BPCD         Lbs/hr FEED       Lbs/hr SULFUR
               Total             100                                            491056         6.03835E+06       18791.4
               Average                   .844145     36.1252        .311201

                **** MATERIAL BALANCE ****

                      CRUDE UNIT
              No. Name          BPCD        Lbs/hr         IBP         EBP          S.G.       API            SULFUR WT%  Lbs/hr Su
                      *** FEED ***
              0   CRUDE FEED    491056      6.03835E+06    60          1240         .844145    36.1252         .311201      18791.4
                      *** PRODUCT ***
              2   OVERHEAD      48884.4     453178         60          170.144      .636398    90.8453         .014716      66.6895
              28  LSR           33522       329279         60          170.144      .674316    78.3423         .0202627     66.7207
              3   NAPHTHA       85542.2     942528         170.144     321.814      .756386    55.5738         .0148748     140.199
              4   KEROSENE      127297      1.54469E+06    321.814     560          .833017    38.3645         .0623558     963.206
              5   LGO           56015.7     718865         560         660          .880983    29.116          .219173      1575.56
              1   REDUCED CRUDE 173317      2.37909E+06    660         1240         .942321    18.6611         .67445       16045.7

                      VACUUM UNIT
              No. Name          BPCD        Lbs/hr         IBP         EBP          S.G.       API            SULFUR WT%  Lbs/hr Su
                      *** FEED ***
              32  REDUCED CRUDE 173317      2.37909E+06    660         1240         .942321    18.6611         .67445       16045.7
                      *** PRODUCT ***
              6   HVGO          141892      1.90018E+06    660         1050         .919318    22.4184         .412657      7841.21
              7   RESIDUUM      31424.9     478920         1050        1240         1.04621    3.75011         1.7133       8205.33

                      CAT CRACKER
              No. Name          BPCD        Lbs/hr         IBP         EBP          S.G.       API            SULFUR WT%  Lbs/hr Su
                      *** FEED ***
              65  LGO           4219.17     54145.8        560         660          .880983    29.116          .219173      118.673
              64  HVGO          136420      1.8269E+06     660         1050         .919318    22.4184         .412657      7538.82
                      *** TOTAL FEED ***
              8   FCCU FEED     140639      1.88104E+06    560         1050         .918167    22.6114         .407088      7657.49
                      *** PRODUCT ***
              12  LCO           22502.2     318776         430         650          .972502    14.001          .703057      2241.18
              13  HCO           5625.56     88640.2        650         736.636      1.08167    -.683762        1.11083      984.642
              14  CRACKED GAS   78989.4     863821                                  .750732    56.9827         .0407984     352.425
              39  C3/C4 -FCCU   34776       285729                                  .564034    119.371         0            0
             *** PRODUCT ***
              < 18 > LE FROM CAT CRACKER (FOE)= 13087.4
              AVAILABLE C3/C4 OLEFINS= 34776
              CONVERSION Wt%= 78.3409      CONVERSION Vol %= 80
              COKE, WT% 10.4089
              COKE  ,#/HR 195896           Sulfur in Flue Gas,Lbs/hr= 409.427

                      CAT POLY UNIT
              *** FEED ***
              < 10 > CAT POLY FEED= 15000
```

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*** PRODUCT ***
< 15 > POLYMER= 6114.52
< 16 > LE FROM POLY (FOE)= 4713.78

                ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 28624
< 62 > C3/C4 TO ALKYL= 19776
< 20 > I-C4 FR. GAS PLANT= 6994.63
< 21 > I-C4 IMPORTED= 1853.34
*** PRODUCT ***
< 50 > ALKYLATE= 20421.8
< 63 > LE FROM ALKYL (FOE)= 2457.09

                CATALYTIC REFORMER UNIT
 No. Name          BPCD       Lbs/hr        IBP         EBP        S.G.       API        SULFUR WT%  Lbs/hr Su
                *** FEED ***
  9  REFORMER FEED 71000      782298        170.144     321.814    .756386    55.5738       0           0
                *** PRODUCT ***
 17  REFORMATE     61795.7    729045                               .80989     43.2152       0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 5848.58
CONVERSION(LV%)= 87.0362    Severity (RON Clear)= 90    FEED Kw= 11.815

                GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 48884.4
< 57 > LE FROM REFORMER (FOE)= 5848.58
< 18 > LE FROM CAT CRACKER (FOE)= 13087.4
< 16 > LE FROM POLY (FOE)= 4713.78
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 19499
< 20 > I-C4 FR. GAS PLANT= 6994.63
< 49 > REF C4 TO BLENDING = 12083.4
< 69 > LSR= 30807.2

                ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 30807.2
*** PRODUCT ***
< 29 > LSR+ISO= 30807.2

*** BY-PASS= 100 %   ***

                GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 30807.2
< 26 > REFORMATE= 56813.7
< 50 > ALKYLATE= 20421.8
< 15 > POLYMER= 6114.52
< 14 > CRACKED GAS= 78989.4
< 49 > REF C4 TO BLENDING = 12083.4
< 68 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 60195
< 23 > UNLEADED REGULAR= 126555
< 24 > UNLEADED PREMIUM= 13901
< 25 > AVIATION GASOLINE= 2579
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      *** GASOLINE COMPOSITION ***

                 LR           UR            UP             AV

LSR           .158861      .167869       0              0
CRACKED GAS   .637762      .25           .644597        0
REFORMATE     .138055      .352472       .136421        0
POLYMER       0            .0483151      0              0
ALKYLATE      0            .124939       .15            .9786
C4            .0653232     .0564045      .0689819       .0214

                      TURBO FUEL BLENDING
      *** FEED ***
      < 30 > LSR= 2714.79
      < 58 > NAPHTHA= 14165.2
      < 59 > KEROSENE= 21112
      *** PRODUCT ***
      < 42 > JET FUEL B= 20883
      < 43 > JET FUEL A= 17109

      *** TURBO FUEL COMPOSITION ***

                     NAPHTHA BASE  KEROSENE BASE

      LSR              .13           0
      NAPHTHA          .58           .12
      KEROSENE         .29           .88

                     DISTILLATE BLENDING
      *** FEED ***
      < 60 > KEROSENE= 106185
      < 40 > LGO= 51796
      < 38 > LCO= 19146.2
      *** PRODUCT ***
      < 44 > STOVE OIL= 5913
      < 45 > LIGHT FUEL OIL= 13398
      < 46 > DIESEL FUEL= 157816

      *** DISTILLATE COMPOSITION ***

                     STOVE OIL     DIESEL FUEL   LFO

      KEROSENE         1             .63           .0632695
      LCO              0             .1            .25113
      LGO              0             .27           .685601

                     HEAVY FUEL OIL BLENDING
      *** FEED ***
      < 41 > LGO= .564941
      < 35 > LCO= 3356
      < 13 > HCO= 5625.56
      < 37 > HVGO= 0
      < 31 > REDUCED CRUDE= 0
      < 34 > VAC RESIDUUM= 15359.9
      *** PRODUCT ***
      < 47 > HEAVY FUEL OIL= 24342
```

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                  OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 6982
< 36 > HVGO TO LUBE OIL= 5472
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 16065
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 377
< 67 > VGO PETROCHEMICAL FEED= 0

                          DISTILLATE DESULFURIZATION

STREAM            TOTAL                 FEED  TO  DDS                                              FINAL STREAM
                  BPCD         BPCD       Lbs/hr       SULFUR WT%               % BYPASS            SULFUR WT%
KEROSENE          127297       127297     1.54469E+06   .0623558                0                   3.11964E-03
LGO               51796.5      51796.6    664720        .219173                 -1.35748E-04        .0219604
LCO               22502.2      11251.1    159388        .703057                 50                  .387909
HCO               5625.56      0          0             1.11083                 100                 1.11083
VAC RESIDUUM      15359.9      0          0             1.7133                  100                 1.7133


  ***PRODUCT SLATES & SPECIFICATIONS***

               JET FUEL B   JET FUEL A    STOVE OIL    LFO          DIESEL FUEL   HFO

BPCD           20883        17109         5913         13398        157816        24342
S.G.           .76794       .823821       .833017      .900931      .859916       1.04424
ASTM 10%       198.253      340.685       386.182      511.187      400.792
ASTM 20%       219.647      366.419       400.551      545.273      428.233
ASTM 50%       275.418      431.587       447.744      592.996      504.115
ASTM 90%       470.866      516.886       519.593      626.728      607.382
RVP,psia       2.56867
Sulfur Wt %    .0117914     4.41314E-03   3.11779E-03  .119698      .0516962      1.39871
Flash Point,F  59.6312      131.397       145.354      215.095      153.175
Pour Point,F   -97.9965     -50.694       -43.8387     -10.8165     -33.2053
Cetane No.                                                          42.4845
Visc @100F,cs  .769495      1.60317       1.83069      4.93126      2.55453       1217.58
Visc @122F,cs  .678863      1.36749       1.55016      3.89203      2.11737       454.812
Watsons K      11.7932      11.6414       11.6071      11.2411      11.4465       10.7236
MeABP          282.812      422.107       443.937      576.75       493.661       944.27

               GASOLINE

LEADED REGULAR,BPCD          60195
TEL Addition,cc/IG: .22
RON / MON / (R+M)/2 (Clear)  90.6615 / 81.503 / 86.0823
RON / MON / (R+M)/2          91.7444 / 82.4373 / 87.0909
RVP,psia                     10.17

MMT Addition,mg/l: 18
UNLEADED REGULAR,BPCD        126555
RON / MON / (R+M)/2          91.3 / 82.8917 / 87.0959
RVP,psia                     10.1745

UNLEADED PREMIUM,BPCD        13901
RON / MON / (R+M)/2          94.6999 / 85.4017 / 90.0508
RVP,psia                     9.7869
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```
AVIATION GASOLINE,BPCD      2579
RON / MON / (R+M)/2         93 / 90.8 / 91.9
RVP,psia                    10


                         STREAMS

< 0 > CRUDE FEED= 491056                        < 1 > REDUCED CRUDE= 173317
< 2 > OVERHEAD= 48884.4                         < 3 > NAPHTHA= 85542.2
< 4 > KEROSENE= 127297                          < 5 > LGO= 56015.7
< 6 > HVGO= 141892                              < 7 > RESIDUUM= 31424.9
< 8 > FCCU FEED= 140639                         < 9 > REFORMER FEED= 71000
< 10 > CAT POLY FEED= 15000                     < 11 > ALKYLATION FEED= 28624
< 12 > LCO= 22502.2                             < 13 > HCO= 5625.56
< 14 > CRACKED GAS= 78989.4                     < 15 > POLYMER= 6114.52
< 16 > LE FROM POLY (FOE)= 4713.78              < 17 > REFORMATE= 61795.7
< 18 > LE FROM CAT CRACKER (FOE)= 13087.4       < 19 > FUEL GAS (FOE)= 19499
< 20 > I-C4 FR. GAS PLANT= 6994.63              < 21 > I-C4 IMPORTED= 1853.34
< 22 > LEADED REGULAR= 60195                    < 23 > UNLEADED REGULAR= 126555
< 24 > UNLEADED PREMIUM= 13901                  < 25 > AVIATION GASOLINE= 2579
< 26 > REFORMATE= 54813.7                       < 27 > NAPHTHA SPECIALTIES= 6982
< 28 > LSR= 33522                               < 29 > LSR+ISO= 30807.2
< 30 > LSR= 2714.79                             < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 173317                    < 33 > VAC RESID TO ASPHALT PLANT= 16065
< 34 > VAC RESIDUUM= 15359.9                    < 35 > LCO= 3356
< 36 > HVGO TO LUBE OIL= 5472                   < 37 > HVGO= 0
< 38 > LCO= 19146.2                             < 39 > C3/C4 -FCCU= 34776
< 40 > LGO= 51796                               < 41 > LGO= .564941
< 42 > JET FUEL B= 20883                        < 43 > JET FUEL A= 17109
< 44 > STOVE OIL= 5913                          < 45 > LIGHT FUEL OIL= 13398
< 46 > DIESEL FUEL= 157816                      < 47 > HEAVY FUEL OIL= 24342
< 48 > RESID TO COKING= 0                       < 49 > REF C4 TO BLENDING = 12083.4
< 50 > ALKYLATE= 20421.8                        < 51 > CRUDE LIGHT ENDS= 3.12845
< 52 > TOTAL PRODUCT= 471587                    < 53 > C2 % IN CRUDE FEED= .10416
< 54 > C3 % IN CRUDE FEED= .87234               < 55 > I-C4 % IN CRUDE FEED= .41795
< 56 > N-C4 % IN CRUDE FEED= 1.734              < 57 > LE FROM REFORMER (FOE)= 5848.58
< 58 > NAPHTHA= 14165.2                         < 59 > KEROSENE= 21112
< 60 > KEROSENE= 106185                         < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 19776                    < 63 > LE FROM ALKYL (FOE)= 2457.09
< 64 > HVGO= 136420                             < 65 > LGO = 4219.17
< 66 > NAPHTHA PETROCHEMICAL FEED= 377          < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                           < 69 > LSR= 30807.2



                         LIGHT ENDS BALANCE

                            *** FROM ***
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              CRUDE UNIT    REFORMER     CAT CRACKER   POLY        ALKYL       ISO        TOTAL
C2   ,#/HR     2682.22       2574.06      42926         0           0           0          48182.3
C3   ,#/HR     31699.2       11657.6      30503.8       13517       14571.1     0          101949
IC4   ,#/HR    16891         10728.5      70737.1       32976.1     0           0          131333
NC4   ,#/HR    72564.1       15657.1      27604.5       11906.7     15697.8     0          143430
H2   ,#/HR     0             10061.4      17569.2       0           0           0          27630.6
C1   ,#/HR     0             2574.06      17798.6       0           0           0          20372.7
H2S   ,#/HR    0             0            3899.18       0           0           0          3899.18
C2=   ,#/HR    0             0            26174.4       0           0           0          26174.4
C3=   ,#/HR    0             0            69276.4       0           0           0          69276.4
C4=   ,#/HR    0             0            107729        0           0           0          107729
TOTAL   ,#/HR  123837        53252.7      414218        58399.8     30268.9     0          679976
BPCD (FOE)     10022         5848.57      35802.2       4713.78     2457.09     0          58843.6

                          *** TO ***
              POLY          ALKY         GAS BLEND     PC FEED     DDS         FUEL GAS   TOTAL
C2   ,#/HR     0             0            0             0           0           48182.3    48182.3
C3   ,#/HR     11052.1       14571.1      0             0           0           76325.5    101949
IC4   ,#/HR    30511.2       97791.7      2622.58       0           0           407.209    131333
NC4   ,#/HR    11906.7       15697.8      100259        0           0           15566.7    143430
H2   ,#/HR     0             0            0             0           15896       11734.6    27630.6
C1   ,#/HR     0             0            0             0           0           20372.7    20372.7
H2S   ,#/HR    0             0            0             0           0           3899.18    3899.18
C2=   ,#/HR    0             0            0             0           0           26174.4    26174.4
C3=   ,#/HR    23307.3       30728.3      0             0           0           15240.8    69276.4
C4=   ,#/HR    46467         61262        0             0           0           0          107729
TOTAL   ,#/HR  123244        220051       102882        0           15896       217903     679976
BPCD (FOE)     9820.21       17570.1      8285.48       0           3668.8      19499      58843.6
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                         **** OVERALL MASS BALANCE ****
*** FEED ***

                         BPCD                     #/HR

CRUDE                     491056                   6.03835E+06
BUTANE                    1853.34                  15253
TOTAL                     492909                   6.0536E+06


*** PRODUCT ***

FUEL GAS (FOE)            19499                    217903
MOTOR GASOLINE            203230                   2.18587E+06
AVIATION TURBO FUELS      37992                    438928
DISTILLATES               177127                   2.22445E+06
HEAVY FUEL OIL            24342                    370277
OTHER PRODUCTS            28896                    404637
H2 TO DESULFURIZERS (FOE) 3668.8                   15896
COKE (FOE)                10433.4                  195896
TOTAL                     505188                   6.05386E+06
```

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TIME:14.52.47 DATE:MONAPR301984121 40
        REFINERY SIMULATION PROGRAM
        CASE:WESBAS40 REGION:WESTERN
         **** FEED BLEND ****
          CRUDE ORIGIN               LV %          BPCD
           CANDNL                    65.1          320336
           SYNCRUDE                  31.5          155002
           CONDENSA                  3.6           16730.3
            No.  MBP          LV %        S.G.        API           SULFUR WT%  BPCD          Lbs/hr FEED     Lbs/hr SULFUR
            Total             100                                               492068          6.0508E+06      18830.1
            Average                      .844145      36.1252        .311201

            **** MATERIAL BALANCE ****

                     CRUDE UNIT
          No. Name        BPCD           Lbs/hr        IBP         EBP         S.G.       API             SULFUR WT%   Lbs/hr Su
                     *** FEED ***
          0   CRUDE FEED  492068         6.0508E+06    60          1240        .844146    36.125          .3112        18830.1
                     *** PRODUCT ***
          2   OVERHEAD    48920          453436        60          170.011     .636296    90.8807         .0147132     66.7149
          28  LSR         33525.9        329273        60          170.011     .674227    78.37           .0202738     66.7562
          3   NAPHTHA     86251.1        950527        170.011     322.634     .756536    55.5367         .014897      141.6
          4   KEROSENE    127092         1.5425E+06    322.634     560         .833178    38.3317         .0625075     964.18
          5   LGO         56131.2        720347        560         660         .880983    29.116          .219173      1578.81
          1   REDUCED CRUDE 173674       2.38399E+06   660         1240        .942321    18.6611         .67445       16078.8

                     VACUUM UNIT
          No. Name        BPCD           Lbs/hr        IBP         EBP         S.G.       API             SULFUR WT%   Lbs/hr Su
                     *** FEED ***
          32  REDUCED CRUDE 173674       2.38399E+06   660         1240        .942321    18.6611         .67445       16078.8
                     *** PRODUCT ***
          6   HVGO        142187         1.90413E+06   660         1050        .919318    22.4184         .412657      7857.51
          7   RESIDUUM    31486.5        479859        1050        1240        1.04621    3.75011         1.7133       8221.42

                     CAT CRACKER
          No. Name        BPCD           Lbs/hr        IBP         EBP         S.G.       API             SULFUR WT%   Lbs/hr Su
                     *** FEED ***
          65  LGO         4519.52        58000.3       560         660         .880983    29.116          .219173      127.121
          64  HVGO        136715         1.83085E+06   660         1050        .919318    22.4184         .412657      7555.12
                     *** TOTAL FEED ***
          8   FCCU FEED   141235         1.88885E+06   560         1050        .918091    22.6242         .406714      7682.24
                     *** PRODUCT ***
          12  LCO         22597.6        320082        430         650         .972365    14.0215         .702439      2248.38
          13  HCO         5649.4         89010.1       650         736.633     1.0816     -.675293        1.10985      987.878
          14  CRACKED GAS 79344.8        867682                                .75071     56.9882         .0407482     353.565
          39  C3/C4 -FCCU 34928.6        286979                                .564025    119.375         0            0
        *** PRODUCT ***
        < 18 > LE FROM CAT CRACKER (FOE)= 13133.8
        AVAILABLE C3/C4 OLEFINS= 34928.6
        CONVERSION Wt%= 78.3418      CONVERSION Vol %= 80
        COKE, WT% 10.3958
        COKE  ,#/HR 196463           Sulfur in Flue Gas,Lbs/hr= 410.719

                      CAT POLY UNIT
        *** FEED ***
        < 10 > CAT POLY FEED= 15000
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*** PRODUCT ***
< 15 > POLYMER= 6114.78
< 16 > LE FROM POLY (FOE)= 4713.39

          ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 28845.2
< 62 > C3/C4 TO ALKYL= 19928.6
< 20 > I-C4 FR. GAS PLANT= 7194.93
< 21 > I-C4 IMPORTED= 1721.69
*** PRODUCT ***
< 50 > ALKYLATE= 20580.5
< 63 > LE FROM ALKYL (FOE)= 2475.18

          CATALYTIC REFORMER UNIT
 No. Name          BPCD      Lbs/hr        IBP        EBP        S.G.        API        SULFUR WT%   Lbs/hr Su
          *** FEED ***
 9   REFORMER FEED 71500     787963        170.011    322.634    .756536    55.5367       0            0
          *** PRODUCT ***
 17  REFORMATE     61284.9   719317                              .805744    44.1142       0            0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 7754.42
CONVERSION(LV%)= 85.7132    Severity (RON Clear)= 92.8  FEED KW= 11.8145

          GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 48920
< 57 > LE FROM REFORMER (FOE)= 7754.42
< 18 > LE FROM CAT CRACKER (FOE)= 13133.8
< 16 > LE FROM POLY (FOE)= 4713.39
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 21368.5
< 20 > I-C4 FR. GAS PLANT= 7194.93
< 49 > REF C4 TO BLENDING = 12075.9
< 69 > LSR= 30811.1

          ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 30811.1
*** PRODUCT ***
< 29 > LSR+ISO= 30811.1

*** BY-PASS= 100 %   ***

          GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 30811.1
< 26 > REFORMATE= 54302.9
< 50 > ALKYLATE= 20580.5
< 15 > POLYMER= 6114.78
< 14 > CRACKED GAS= 79344.8
< 49 > REF C4 TO BLENDING = 12075.9
< 68 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 20065
< 23 > UNLEADED REGULAR= 166585
< 24 > UNLEADED PREMIUM= 13901
< 25 > AVIATION GASOLINE= 2579
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*** GASOLINE COMPOSITION ***

              LR           UR           UP           AV

LSR           .448439      .130865      0            0
CRACKED GAS   .457405      .37          .611003      0
REFORMATE     .0511585     .319623      0            0
POLYMER       0            .0366846     0            0
ALKYLATE      0            .0808004     .33          .9786
C4            .0429977     .0620271     .0589972     .0214

                  TURBO FUEL BLENDING
    *** FEED ***
    < 30 > LSR= 2714.79
    < 58 > NAPHTHA= 14376
    < 59 > KEROSENE= 20903.2
    *** PRODUCT ***
    < 42 > JET FUEL B= 20683
    < 43 > JET FUEL A= 17109

    *** TURBO FUEL COMPOSITION ***

                  NAPHTHA BASE  KEROSENE BASE

    LSR             .13           0
    NAPHTHA         .59           .12
    KEROSENE        .28           .88

                  DISTILLATE BLENDING
    *** FEED ***
    < 60 > KEROSENE= 106189
    < 40 > LCO= 51611.6
    < 38 > LGO= 19326.6
    *** PRODUCT ***
    < 44 > STOVE OIL= 5913
    < 45 > LIGHT FUEL OIL= 13398
    < 46 > DIESEL FUEL= 157816

    *** DISTILLATE COMPOSITION ***

                  STOVE OIL     DIESEL FUEL   LFO

    KEROSENE       1              .63           .0635674
    LCO            0              .1            .264592
    LGO            0              .27           .671841

                  HEAVY FUEL OIL BLENDING
    *** FEED ***
    < 41 > LCO= .0532227
    < 35 > LCO= 3271
    < 13 > HCO= 5649.4
    < 37 > HVGO= 0
    < 31 > REDUCED CRUDE= 0
    < 36 > VAC RESIDUUM= 15421.5
    *** PRODUCT ***
    < 47 > HEAVY FUEL OIL= 24342
```

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                 OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 6982
< 36 > HVGO TO LUBE OIL= 5472
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 16065
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 377
< 67 > VGO PETROCHEMICAL FEED= 0

                            DISTILLATE DESULFURIZATION

STREAM               TOTAL                  FEED  TO  DDS                                              FINAL STREAM
                     BPCD         BPCD          Lbs/hr      SULFUR WT%                 % BYPASS        SULFUR WT%
KEROSENE             127092       127092        1.5425E+06  .0625075                   0                3.12723E-03
LGO                  51611.7      51611.7       662347      .219173                   -3.78427E-05     .0219605
LCO                  22597.6      11298.8       160041      .702439                    50              .387567
HCO                  5649.4       0             0           1.10985                    100             1.10985
VAC RESIDUUM         15421.5      0             0           1.7133                     100             1.7133


   ***PRODUCT SLATES & SPECIFICATIONS***

                JET FUEL B   JET FUEL A    STOVE OIL     LFO          DIESEL FUEL   HFO

BPCD             20883        17109         5913          13398        157816        24342
S.G.             .767296      .823981       .833178       .902123      .860004       1.0445
ASTM 10%         198.065      341.3         386.942       508.926      401.571
ASTM 20%         219.227      367.077       401.235       543.747      428.835
ASTM 50%         274.306      432.077       448.188       592.34       504.294
ASTM 90%         468.413      516.962       519.673       626.474      607.371
RVP,psia         2.57134
Sulfur Wt %      .0119321     4.42234E-03   3.12537E-03   .124746      .0516514      1.40227
Flash Point,F    59.5304      131.741       145.76        213.842      153.595
Pour Point,F    -98.1424     -50.5157      -43.6621      -12.4326     -33.0639
Cetane No.                                                             42.478
Visc @100F,cs    .765706      1.60759       1.83594       4.90739      2.56007       1269.82
Visc @122F,cs    .67566       1.37106       1.55436       3.87306      2.12168       470.884
Watsons K        11.7976      11.6412       11.6069       11.2227      11.4467       10.7253
MeABP            281.782      422.574       444.405       577.76       493.985       945.99

                 GASOLINE

LEADED REGULAR,BPCD              20065
TEL Addition,cc/IG: 1.24
RON / MON / (R+M)/2 (Clear)      85.3115 / 78.1682 / 81.7399
RON / MON / (R+M)/2              90.823 / 83.1471 / 86.9851
RVP,psia                         10.8717

MMT Addition,mg/l: 0
UNLEADED REGULAR,BPCD            166685
RON / MON / (R+M)/2              91.3 / 82.759 / 87.0295
RVP,psia                         10.092

UNLEADED PREMIUM,BPCD            13901
RON / MON / (R+M)/2              93.7429 / 86.3273 / 90.0351
RVP,psia                         9.80215
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AVIATION GASOLINE,BPCD          2579
RON / MON / (R+M)/2             93 / 90.8 / 91.9
RVP,psia                        10

                         STREAMS

< 0 > CRUDE FEED= 492068                      < 1 > REDUCED CRUDE= 173674
< 2 > OVERHEAD= 68920                         < 3 > NAPHTHA= 86251.1
< 4 > KEROSENE= 127092                        < 5 > LGO= 56131.2
< 6 > HVGO= 142187                            < 7 > RESIDUUM= 31486.5
< 8 > FCCU FEED= 141235                       < 9 > REFORMER FEED= 71500
< 10 > CAT POLY FEED= 15000                   < 11 > ALKYLATION FEED= 28845.2
< 12 > LCO= 22597.6                           < 13 > HCO= 5649.4
< 14 > CRACKED GAS= 79344.8                   < 15 > POLYMER= 6114.78
< 16 > LE FROM POLY (FOE)= 4713.39            < 17 > REFORMATE= 61284.9
< 18 > LE FROM CAT CRACKER (FOE)= 13133.8     < 19 > FUEL GAS (FOE)= 21368.5
< 20 > I-C4 FR. GAS PLANT= 7194.93            < 21 > I-C4 IMPORTED= 1721.69
< 22 > LEADED REGULAR= 20065                  < 23 > UNLEADED REGULAR= 166685
< 24 > UNLEADED PREMIUM= 13901                < 25 > AVIATION GASOLINE= 2579
< 26 > REFORMATE= 54302.9                     < 27 > NAPHTHA SPECIALTIES= 6982
< 28 > LSR= 33525.9                           < 29 > LSR+ISO= 30811.1
< 30 > LSR= 2714.79                           < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 173674                  < 33 > VAC RESID TO ASPHALT PLANT= 16065
< 34 > VAC RESIDUUM= 15421.5                  < 35 > LCO= 3271
< 36 > HVGO TO LUBE OIL= 5472                 < 37 > HVGO= 0
< 38 > LCO= 19326.6                           < 39 > C3/C4 -FCCU= 34928.6
< 40 > LGO= 51611.6                           < 41 > LGO= .0532227
< 42 > JET FUEL B= 20883                      < 43 > JET FUEL A= 17109
< 44 > STOVE OIL= 5913                        < 45 > LIGHT FUEL OIL= 13398
< 46 > DIESEL FUEL= 157816                    < 47 > HEAVY FUEL OIL= 24342
< 48 > RESID TO COKING= 0                     < 49 > REF C4 TO BLENDING = 12075.9
< 50 > ALKYLATE= 20580.5                      < 51 > CRUDE LIGHT ENDS= 3.12845
< 52 > TOTAL PRODUCT= 471587                  < 53 > C2 % IN CRUDE FEED= .10416
< 54 > C3 % IN CRUDE FEED= .87234             < 55 > I-C4 % IN CRUDE FEED= .41795
< 56 > N-C4 % IN CRUDE FEED= 1.734            < 57 > LE FROM REFORMER (FOE)= 7754.42
< 58 > NAPHTHA= 14374                         < 59 > KEROSENE= 20903.2
< 60 > KEROSENE= 106189                       < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 19928.6                < 63 > LE FROM ALKYL (FOE)= 2475.18
< 64 > HVGO= 136715                           < 65 > LGO = 4519.52
< 66 > NAPHTHA PETROCHEMICAL FEED= 377        < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                         < 69 > LSR= 30811.1




                        LIGUT ENDS BALANCE

                          *** FROM ***
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              CRUDE UNIT   REFORMER    CAT CRACKER  POLY       ALKYL      ISO       TOTAL
C2   ,#/HR    2687.75      4355.44     43070.5      0          0          0         50113.7
C3   ,#/HR    31764.6      15069.3     30633        13515.3    14681.3    0         105663
IC4   ,#/HR   16925.8      12425.4     71055.6      32979.5    0          0         133386
NC4   ,#/HR   72713.7      18133.6     27710.7      11900.3    15810.4    0         146269
H2   ,#/HR    0            14306.4     17628.4      0          0          0         31934.8
C1   ,#/HR    0            4355.44     17858.5      0          0          0         22213.9
H2S   ,#/HR   0            0           3911.8       0          0          0         3911.8
C2=   ,#/HR   0            0           26262.5      0          0          0         26262.5
C3=   ,#/HR   0            0           69624.1      0          0          0         69624.1
C4=   ,#/HR   0            0           108174       0          0          0         108174
TOTAL   ,#/HR 124092       68645.6     415929       58395.1    30491.7    0         697553
BPCD (FOE)    10042.7      7754.4      35948        4713.4     2475.18    0         60933.6

                        *** TO ***
              POLY         ALKY        GAS BLEND    PC FEED    DDS        FUEL GAS  TOTAL
C2   ,#/HR    0            0           0            0          0          50113.7   50113.7
C3   ,#/HR    11050.4      14681.3     0            0          0          79931.8   105663
IC4   ,#/HR   30514.7      99755.2     2633.53      0          0          482.907   133386
NC4   ,#/HR   11900.3      15810.4     100184       0          0          18374     146269
H2   ,#/HR    0            0           0            0          15869      16065.8   31934.8
C1   ,#/HR    0            0           0            0          0          22213.9   22213.9
H2S   ,#/HR   0            0           0            0          0          3911.8    3911.8
C2=   ,#/HR   0            0           0            0          0          26262.5   26262.5
C3=   ,#/HR   23321.9      30984.9     0            0          0          15317.3   69624.1
C4=   ,#/HR   46455.1      61718.9     0            0          0          0         108174
TOTAL   ,#/HR 123242       222951      102818       0          15869      232674    697553
BPCD (FOE)    9820.06      17802.2     8280.32      0          3662.56    21368.5   60933.6
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                         **** OVERALL MASS BALANCE ****
*** FEED ***

                         BPCD                         #/HR

CRUDE                     492068                       6.0508E+06
BUTANE                    1721.69                      14169.5
TOTAL                     493790                       6.06497E+06


*** PRODUCT ***

FUEL GAS (FOE)            21368.5                      232674
MOTOR GASOLINE            203230                       2.18195E+06
AVIATION TURBO FUELS      37992                        438772
DISTILLATES               177127                       2.2249E+06
HEAVY FUEL OIL            24342                        370369
OTHER PRODUCTS            28896                        404217
H2 TO DESULFURIZERS (FOE) 3662.56                      15869
COKE (FOE)                10463.6                      196463
TOTAL                     507082                       6.06522E+06
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"B"

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TIME:00.38.31 DATE:WEDAPR251984116 42
          REFINERY SIMULATION PROGRAM
         CASE:ATLBAS11 REGION:ATLANTIC
          **** FEED BLEND ****
            CRUDE ORIGIN                      LV %           BPCD
             FRONTIER                         33             45007.3
             VENEZL                           7              9547
             ARABL                            30.6           41734
             SYNCRUDE                         15             20457.9
             MEXL                             9.9            13502.2
             NORTHSEA                         4.5            6137.36
              No.  MBP              LV %        S.G.         API          SULFUR WT%  BPCD         Lbs/hr FEED      Lbs/hr SULFUR
               Total                100                                               136386          1.7232E+06     20723.8
               Average                        .867354      31.6399        1.20263

                **** MATERIAL BALANCE ****

                              CRUDE UNIT
              No. Name              BPCD        Lbs/hr        IBP          EBP         S.G.        API          SULFUR WT%   Lbs/hr Su
                              *** FEED ***
              0   CRUDE FEED        136386      1.7232E+06    60           1360        .867353     31.6401       1.20263       20723.8
                              *** PRODUCT ***
              2   OVERHEAD          8701.33     81284.9       60           170.173     .641289     89.1493       .0146331      11.8945
              28  LSR               6507.37     63269         60           170.173     .667445     80.5025       .0187834      11.8841
              3   NAPHTHA           11533.6     122041        170.173      272.139     .726394     63.2979       .0227664      27.7844
              4   KEROSENE          37083.7     436241        272.139      540         .807557     43.7198       .170345       743.114
              5   LGO               17023.4     215875        540          660         .870536     31.0435       .767538       1656.93
              1   REDUCED CRUDE 62043.7     867757        660          1360        .960131     15.8757       2.10705       18284.1

                              VACUUM UNIT
              No. Name              BPCD        Lbs/hr        IBP          EBP         S.G.        API          SULFUR WT%   Lbs/hr Su
                              *** FEED ***
              32  REDUCED CRUDE 62043.7     867757        660          1360        .960131     15.8757       2.10705       18284.1
                              *** PRODUCT ***
              6   HVGO              43933       589179        660          1050        .920633     22.1986       1.3757        8105.34
              7   RESIDUUM          18110.7     278579        1050         1360        1.05595     2.50256       3.65395       10179.1

                              CAT CRACKER
              No. Name              BPCD        Lbs/hr        IBP          EBP         S.G.        API          SULFUR WT%   Lbs/hr Su
                              *** FEED ***
              65  LGO               0           0             540          660         .870536     31.0435       .767538       0
              64  HVGO              43870       588335        660          1050        .920633     22.1986       1.3757        8093.72
                              *** TOTAL FEED ***
              8   FCCU FEED         43870       588335        540          1050        .920633     22.1986       1.3757        8093.72
                              *** PRODUCT ***
              12  LCO               10283.1     144615        430          650         .965424     15.0677       1.82822       2643.87
              13  HCO               2570.78     39591.7       650          775.239     1.05723     2.34032       2.88859       1143.64
              14  CRACKED GAS       22517.4     245370                                 .748055     57.6572       .170228       417.689
              39  C3/C4 -FCCU       9156.68     75248.9                                .564147     119.321       0             0
             *** PRODUCT ***
             < 18 > LE FROM CAT CRACKER (POE)= 2906.93
             AVAILABLE C3/C4 OLEFINS= 9156.68
             CONVERSION Wt%= 68.6902      CONVERSION Vol %= 70.7
             COKE, WT% 8.85311
             COKE  ,#/HR 52112.7          Sulfur in Flue Gas,Lbs/hr= 356.051
```

```
                  CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 9156.68
*** PRODUCT ***
< 15 > POLYMER= 3734.99
< 16 > LE FROM POLY (FOE)= 2876.56

                  ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 0
< 62 > C3/C4 TO ALKYL= 0
< 20 > I-C4 FR. GAS PLANT= 0
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 0
< 63 > LE FROM ALKYL (FOE)= 0

                  CATALYTIC REFORMER UNIT
 No. Name              BPCD       Lbs/hr        IBP        EBP         S.G.      API        SULFUR WT%  Lbs/hr Su
                  *** FEED ***
 9   REFORMER FEED 8900         94174.3       170.173    272.139     .726394   63.2979      0           0
                  *** PRODUCT ***
 17  REFORMATE      6716.79     77211.3                              .789131   47.8111      0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 1997.19
CONVERSION(LV%)= 75.4696    Severity (RON Clear)= 98    FEED KW= 12.1711

                  GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 8701.33
< 57 > LE FROM REFORMER (FOE)= 1997.19
< 18 > LE FROM CAT CRACKER (FOE)= 2906.93
< 16 > LE FROM POLY (FOE)= 2876.56
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 6206.62
< 20 > I-C4 FR. GAS PLANT= 0
< 49 > REF C4 TO BLENDING = 2772.15
< 69 > LSR= 6313.66

                  ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 6313.66
*** PRODUCT ***
< 29 > LSR+ISO= 6212.64

*** BY-PASS= 0 %   ***

                  GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 6212.64
< 26 > REFORMATE= 6716.79
< 50 > ALKYLATE= 0
< 15 > POLYMER= 3734.99
< 14 > CRACKED GAS= 22517.4
< 49 > REF C4 TO BLENDING = 2772.15
< 68 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 12580
```

```
      < 23 > UNLEADED REGULAR= 26418
      < 24 > UNLEADED PREMIUM= 2956
      < 25 > AVIATION GASOLINE= 0

      *** GASOLINE COMPOSITION ***

                LR           UR           UP           AV

LSR             .308657      .0881875     0            0
CRACKED GAS     .382179      .63          .360708      0
REFORMATE       .256065      .0692869     .563287      0
POLYMER         0            .141381      0            0
ALKYLATE        0            0            0            .9786
C4              .0530985     .071145      .0760044     .0214

                      TURBO FUEL BLENDING
      *** FEED ***
      < 30 > LSR= 193.71
      < 58 > NAPHTHA= 1285.58
      < 59 > KEROSENE= 4684.71
      *** PRODUCT ***
      < 42 > JET FUEL B= 1761
      < 43 > JET FUEL A= 4403

      *** TURBO FUEL COMPOSITION ***

                      NAPHTHA BASE  KEROSENE BASE

      LSR               .11           0
      NAPHTHA           .48           .1
      KEROSENE          .41           .9

                      DISTILLATE BLENDING
      *** FEED ***
      < 60 > KEROSENE= 32399
      < 40 > LGO= 17022.9
      < 38 > LCO= 7566.13
      *** PRODUCT ***
      < 44 > STOVE OIL= 2390
      < 45 > LIGHT FUEL OIL= 26607
      < 46 > DIESEL FUEL= 27991

      *** DISTILLATE COMPOSITION ***

                      STOVE OIL     DIESEL FUEL   LFO

      KEROSENE          1             .607          .489286
      LCO               0             .139          .138136
      LGO               0             .254          .372578

                      HEAVY FUEL OIL BLENDING
      *** FEED ***
      < 41 > LGO= .491455
      < 35 > LCO= 2717
      < 13 > HCO= 2570.78
      < 37 > HVGO= 0
      < 31 > REDUCED CRUDE= 0
      < 34 > VAC RESIDUUM= 8612.73
```

```
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 13901

           OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 0
< 36 > HVGO TO LUBE OIL= 63
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 9498
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 1348
< 67 > VGO PETROCHEMICAL FEED= 0

                          DISTILLATE DESULFURIZATION

STREAM              TOTAL              FEED  TO  DDS                                    FINAL STREAM
                    BPCD        BPCD       Lbs/hr      SULFUR WT%             % BYPASS   SULFUR WT%
KEROSENE            37083.7     37083.7    436241      .170345                0          8.53106E-03
LGO                 17023.4     17023.4    215875      .767538                0          .0772877
LCO                 10283.1     7198.19    101231      1.82822                29.9998    .68432
HCO                 2570.78     0          0           2.88859                100        2.88859
VAC RESIDUUM        8612.73     0          0           3.65395                100        3.65395


  ***PRODUCT SLATES & SPECIFICATIONS***

                 JET FUEL B   JET FUEL A    STOVE OIL     LFO          DIESEL FUEL   HFO

BPCD              1761         4403          2390          26607        27991         13901
S.G.              .753186      .79944        .807557       .852828      .845497       1.03849
ASTM 10%          205.915      311.756       344.898       368.892      361.971
ASTM 20%          221.322      335.361       362.423       410.794      393.61
ASTM 50%          262.03       398.298       411.931       518.424      483.289
ASTM 90%          470.149      494.512       496.885       610.471      603.48
RVP,psia          2.85336
Sulfur Wt %       .0161143     9.81198E-03   8.51726E-03   .138914      .132373       2.96873
Flash Point,F     64.0597      115.238       126.491       140.022      135.913
Pour Point,F     -80.9626     -50.3417      -45.3705      -29.3593     -37.1592
Cetane No.                                                               44.8839
Visc @100F,cs     .78293       1.33347       1.47524       2.4814       2.16093       1261.13
Visc @122F,cs     .691046      1.15008       1.26588       2.06315      1.81158       474.214
Watsons K         12.0525      11.8584       11.8201       11.5295      11.5432       10.796
MeABP             288.074      392.009       409.731       490.653      469.649       949.36

                 GASOLINE

LEADED REGULAR,BPCD          12580
TEL Addition,cc/IG: 1.24
RON / MON / (R+M)/2 (Clear)  89.8754 / 81.7256 / 85.8005
RON / MON / (R+M)/2          94.3376 / 85.478 / 89.9078
RVP,psia                     11.3527

MMT Addition,mg/l: 18
UNLEADED REGULAR,BPCD        26418
RON / MON / (R+M)/2          93.9 / 84.2098 / 89.0549
RVP,psia                     10.2756

UNLEADED PREMIUM,BPCD        2956
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RON / MON / (R+M)/2          96.7 / 87.0223 / 91.8611
RVP,psia                     9.84803

AVIATION GASOLINE,BPCD       0
RON / MON / (R+M)/2          93 / 90.8 / 91.9
RVP,psia                     10
```

STREAMS

```
< 0 > CRUDE FEED= 136386                          < 1 > REDUCED CRUDE= 62043.7
< 2 > OVERHEAD= 8701.33                           < 3 > NAPHTHA= 11533.6
< 4 > KEROSENE= 37083.7                           < 5 > LGO= 17023.4
< 6 > HVGO= 43933                                 < 7 > RESIDUUM= 18110.7
< 8 > FCCU FEED= 43870                            < 9 > REFORMER FEED= 8900
< 10 > CAT POLY FEED= 9156.68                     < 11 > ALKYLATION FEED= 0
< 12 > LCO= 10283.1                               < 13 > HCO= 2570.78
< 14 > CRACKED GAS= 22517.4                       < 15 > POLYMER= 3734.99
< 16 > LE FROM POLY (FOE)= 2876.54                < 17 > REFORMATE= 6716.79
< 18 > LE FROM CAT CRACKER (FOE)= 2906.93         < 19 > FUEL GAS (FOE)= 6206.62
< 20 > I-C4 FR. GAS PLANT= 0                      < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 12580                      < 23 > UNLEADED REGULAR= 26418
< 24 > UNLEADED PREMIUM= 2956                     < 25 > AVIATION GASOLINE= 0
< 26 > REFORMATE= 6716.79                         < 27 > NAPHTHA SPECIALTIES= 0
< 28 > LSR= 6507.37                               < 29 > LSR+ISO= 6212.64
< 30 > LSR= 193.71                                < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 62043.7                     < 33 > VAC RESID TO ASPHALT PLANT= 9498
< 34 > VAC RESIDUUM= 8612.73                      < 35 > LCO= 2717
< 36 > HVGO TO LUBE OIL= 63                       < 37 > HVGO= 0
< 38 > LCO= 7566.13                               < 39 > C3/C4 -FCCU= 9156.68
< 40 > LGO= 17022.9                               < 41 > LGO= .491455
< 42 > JET FUEL B= 1761                           < 43 > JET FUEL A= 4403
< 44 > STOVE OIL= 2390                            < 45 > LIGHT FUEL OIL= 26607
< 46 > DIESEL FUEL= 27991                         < 47 > HEAVY FUEL OIL= 13901
< 48 > RESID TO COKING= 0                         < 49 > REF C4 TO BLENDING = 2772.15
< 50 > ALKYLATE= 0                                < 51 > CRUDE LIGHT ENDS= 1.60865
< 52 > TOTAL PRODUCT= 129916                      < 53 > C2 % IN CRUDE FEED= .02451
< 54 > C3 % IN CRUDE FEED= .31962                 < 55 > I-C4 % IN CRUDE FEED= .19662
< 56 > N-C4 % IN CRUDE FEED= 1.0679               < 57 > LE FROM REFORMER (FOE)= 1997.19
< 58 > NAPHTHA= 1285.58                           < 59 > KEROSENE= 4684.71
< 60 > KEROSENE= 32399                            < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 0                          < 63 > LE FROM ALKYL (FOE)= 0
< 64 > HVGO= 43870                                < 65 > LGO = 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 1348           < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                             < 69 > LSR= 6313.66
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                         LIGHT ENDS BALANCE

                           *** FROM ***
              CRUDE UNIT   REFORMER   CAT CRACKER  POLY      ALKYL    ISO       TOTAL
C2  ,#/HR      175.297     1620.97     9289.55     0         0        0          11085.8
C3  ,#/HR      3225.78     4115.03     7905.94     8145.97   0        233.606    23626.3
IC4  ,#/HR     2206.97     2271.03     18521.3     20026.3   0        415.692    43441.3
NC4  ,#/HR     12412       3314.34     7467.12     7467.12   0        1183.69    31844.3
H2  ,#/HR      0           4020.61     3630.98     0         0        0          7651.59
C1  ,#/HR      0           1620.97     3851.76     0         0        0          5472.73
H2S  ,#/HR     0           0           3753.24     0         0        0          3753.24
C2=  ,#/HR     0           0           5664.36     0         0        0          5664.36
C3=  ,#/HR     0           0           18286.1     0         0        0          18286.1
C4=  ,#/HR     0           0           28356.4     0         0        0          28356.4
TOTAL  ,#/HR   18020       16963       106727      35639.4   0        1832.99    179182
BPCD (FOE)     1455.75     1997.19     8851.88     2876.54   0        147.842    15329.2

                           *** TO ***
              POLY         ALKY        GAS BLEND   PC FEED   DDS      FUEL GAS  TOTAL
C2  ,#/HR      0           0           0           0         0        11085.8    11085.8
C3  ,#/HR      6640.99     0           0           0         0        16985.3    23626.3
IC4  ,#/HR     18521.3     0           11731.8     0         0        13188.2    43441.3
NC4  ,#/HR     7467.12     0           11476.2     0         0        12901      31844.3
H2  ,#/HR      0           0           0           0         5460.73  2190.86    7651.59
C1  ,#/HR      0           0           0           0         0        5472.73    5472.73
H2S  ,#/HR     0           0           0           0         0        3753.24    3753.24
C2=  ,#/HR     0           0           0           0         0        5664.36    5664.36
C3=  ,#/HR     14263.1     0           0           0         0        4023       18286.1
C4=  ,#/HR     28356.4     0           0           0         0        0          28356.4
TOTAL  ,#/HR   75248.9     0           23208       0         5460.73  75264.5    179182
BPCD (FOE)     5995.78     0           1866.47     0         1260.34  6206.62    15329.2
```

```
*** FEED ***               **** OVERALL MASS BALANCE ****

                              BPCD                    #/HR
  CRUDE                       136386                  1.7232E+06
  BUTANE                      0                       0
  TOTAL                       136386                  1.7232E+06

*** PRODUCT ***

FUEL GAS (FOE)                6206.62                 75264.5
MOTOR GASOLINE                41954                   444952
AVIATION TURBO FUELS          6164                    70596
DISTILLATES                   56988                   703405
HEAVY FUEL OIL                13901                   210290
OTHER PRODUCTS                10909                   161207
H2 TO DESULFURIZERS (FOE)     1260.34                 5460.73
COKE (FOE)                    2775.52                 52112.7
TOTAL                         140158                  1.72329E+06
```

```
TIME:15.30.26 DATE:FRIAPR271984118 44
         REFINERY SIMULATION PROGRAM
        CASE:ATLBAB10 REGION:ATLANTIC
         **** FEED BLEND ****
          CRUDE ORIGIN                LV %           BPCD
           FRONTIER                   33             45002.1
           VENEZL                     7              9545.91
           ARABL                      30.6           41729.3
           SYNCRUDE                   15             20455.5
           MEXL                       9.9            13500.6
           NORTHSEA                   4.5            6136.66
            No.  MBP              LV %        S.G.        API           SULFUR WT%  BPCD         Lbs/hr FEED     Lbs/hr SULFUR
             Total                100                                               136370         1.723E+06      20721.4
             Average                       .867354     31.6399          1.20263

              **** MATERIAL BALANCE ****

                         CRUDE UNIT
            No. Name          BPCD         Lbs/hr        IBP         EBP         S.G.        API          SULFUR WT%  Lbs/hr Su
                         *** FEED ***
            0   CRUDE FEED    136370       1.723E+06     60          1360        .867354     31.6399       1.20264       20721.4
                         *** PRODUCT ***
            2   OVERHEAD      8689.26      81161.3       60          170.053     .641204     89.1788       .0145977      11.8477
            28  LSR           6495.55      63149         60          170.053     .667391     80.5197       .0187823      11.8608
            3   NAPHTHA       11533.6      122034        170.053     272.064     .726348     63.3102       .0227565      27.7706
            4   KEROSENE      37089.2      436297        272.064     540         .807541     43.7233       .170311       743.062
            5   LGO           17021.4      215850        540         660         .870536     31.0435       .767538       1656.73
            1   REDUCED CRUDE 62036.6      867658        660         1360        .960131     15.8757       2.10705       18282

                         VACUUM UNIT
            No. Name          BPCD         Lbs/hr        IBP         EBP         S.G.        API          SULFUR WT%  Lbs/hr Su
                         *** FEED ***
            32  REDUCED CRUDE 62036.6      867658        660         1360        .960131     15.8757       2.10705       18282
                         *** PRODUCT ***
            6   HVGO          43928        589112        660         1050        .920633     22.1986       1.3757        8104.42
            7   RESIDUUM      18108.6      278547        1050        1360        1.05595     2.50256       3.65395       10178

                         CAT CRACKER
            No. Name          BPCD         Lbs/hr        IBP         EBP         S.G.        API          SULFUR WT%  Lbs/hr Su
                         *** FEED ***
            65  LGO           0            0             540         660         .870536     31.0435       .767538       0
            64  HVGO          43865        588267        660         1050        .920633     22.1986       1.3757        8092.79
                         *** TOTAL FEED ***
            8   FCCU FEED     43865        588267        540         1050        .920633     22.1986       1.3757        8092.79
                         *** PRODUCT ***
            12  LCO           10282        144599        430         650         .965424     15.0677       1.82822       2643.59
            13  HCO           2570.49      39587.3       650         775.239     1.05723     2.34032       2.88859       1143.51
            14  CRACKED GAS   22514.8      245342                                .748055     57.6572       .170229       417.642
            39  C3/C4 -FCCU   9155.64      75240.4                               .564147     119.321       0             0
           *** PRODUCT ***
           < 18 > LE FROM CAT CRACKER (FOE)= 2906.6
           AVAILABLE C3/C4 OLEFINS= 9155.64
           CONVERSION Wt%= 68.6902      CONVERSION Vol %= 70.7
           COKE, WT% 8.8531
           COKE   ,#/HR 52106.7         Sulfur in Flue Gas,Lbs/hr= 355.982
```

```
                CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 9155.64
*** PRODUCT ***
< 15 > POLYMER= 3734.57
< 16 > LE FROM POLY (FOE)= 2876.22

                ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 0
< 62 > C3/C4 TO ALKYL= 0
< 20 > I-C4 FR. GAS PLANT= 0
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 0
< 63 > LE FROM ALKYL (FOE)= 0

                CATALYTIC REFORMER UNIT
 No. Name            BPCD       Lbs/hr         IBP         EBP         S.G.         API          SULFUR WT%   Lbs/hr Su
                *** FEED ***
 9   REFORMER FEED 8900         94168.3        170.053     272.064     .726348     63.3102          0            0
                *** PRODUCT ***
 17  REFORMATE     6716.57      77204.4                                .789086     47.8215          0            0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 1997.32
CONVERSION(LV%)= 75.4671    Severity (RON Clear)= 98    FEED KW= 12.1713

                GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 8689.26
< 57 > LE FROM REFORMER (FOE)= 1997.32
< 18 > LE FROM CAT CRACKER (FOE)= 2906.6
< 16 > LE FROM POLY (FOE)= 2876.22
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 6183.82
< 20 > I-C4 FR. GAS PLANT= 0
< 49 > REF C4 TO BLENDING = 2771.88
< 69 > LSR= 6301.84

                ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 6301.84
*** PRODUCT ***
< 29 > LSR+ISO= 6216.14

*** BY-PASS= 15 %   ***

                GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 6216.14
< 26 > REFORMATE= 6716.57
< 50 > ALKYLATE= 0
< 15 > POLYMER= 3734.57
< 14 > CRACKED GAS= 22514.8
< 49 > REF C4 TO BLENDING = 2771.88
< 68 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 4915
```

```
     < 23 > UNLEADED REGULAR= 34083
     < 24 > UNLEADED PREMIUM= 2956
     < 25 > AVIATION GASOLINE= 0

     *** GASOLINE COMPOSITION ***

               LR           UR           UP           AV

LSR            .666679      .0862427     0            0
CRACKED GAS    .307208      .6           .187792      0
REFORMATE      0            .133152      .736924      0
POLYMER        0            .109573      0            0
ALKYLATE       0            0            0            .9786
C4             .0261127     .0710324     .0752844     .0214

                    TURBO FUEL BLENDING
     *** FEED ***
     < 30 > LSR= 193.71
     < 58 > NAPHTHA= 1265.58
     < 59 > KEROSENE= 4684.71
     *** PRODUCT ***
     < 42 > JET FUEL B= 1761
     < 43 > JET FUEL A= 4403

     *** TURBO FUEL COMPOSITION ***

                    NAPHTHA BASE  KEROSENE BASE

     LSR             .11           0
     NAPHTHA         .48           .1
     KEROSENE        .41           .9

                    DISTILLATE BLENDING
     *** FEED ***
     < 60 > KEROSENE= 32404.5
     < 40 > LGO= 17020.6
     < 38 > LCO= 7562.96
     *** PRODUCT ***
     < 44 > STOVE OIL= 2390
     < 45 > LIGHT FUEL OIL= 26607
     < 46 > DIESEL FUEL= 27991

     *** DISTILLATE COMPOSITION ***

                    STOVE OIL     DIESEL FUEL   LFO

     KEROSENE        1             .607          .489493
     LCO             0             .139          .138017
     LGO             0             .254          .37249

                    HEAVY FUEL OIL BLENDING
     *** FEED ***
     < 41 > LGO= .878174
     < 35 > LCO= 2719
     < 13 > HCO= 2570.49
     < 37 > HVGO= 0
     < 31 > REDUCED CRUDE= 0
     < 34 > VAC RESIDUUM= 8610.63
```

```
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 13901

              OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 0
< 36 > HVGO TO LUBE OIL= 63
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 9498
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 1348
< 67 > VGO PETROCHEMICAL FEED= 0

                         DISTILLATE DESULFURIZATION

STREAM            TOTAL                FEED  TO  DDS                                            FINAL STREAM
                  BPCD         BPCD       Lbs/hr     SULFUR WT%                % BYPASS     SULFUR WT%
KEROSENE          37089.2       37089.2    436297     .170311                  0             8.52935E-03
LGO               17021.4      17021.4    215850     .767538                  0            .0772877
LCO               10282        7197.37    101219     1.82822                  30.0003      .684328
HCO               2570.49      0          0          2.88859                  100          2.88859
VAC RESIDUUM      8610.63      0          0          3.65395                  100          3.65395


   ***PRODUCT SLATES & SPECIFICATIONS***

             JET FUEL B   JET FUEL A    STOVE OIL    LFO          DIESEL FUEL   HFO

BPCD          1761         4403          2390         26607        27991        13901
S.G.          .753152      .799422       .807541      .852797      .845488      1.03847
ASTM 10%      205.842      311.686       344.833      368.809      361.906
ASTM 20%      221.245      335.298       362.366      410.712      393.56
ASTM 50%      261.946      398.264       411.897      518.364      483.277
ASTM 90%      470.137      494.505       496.879      610.466      603.481
RVP,psia      2.78681
Sulfur Wt %   .0161087     9.80948E-03   8.51555E-03  .138822      .132373      2.96825
Flash Point,F 64.0193      115.198       126.456      139.977      135.878
Pour Point,F -80.9778     -50.3543      -45.3832     -29.37       -37.1694
Cetane No.                                                         44.8859
Visc @100F,cs .782688      1.33316       1.47491      2.48043      2.16056      1258.06
Visc @122F,cs .69084       1.14983       1.26562      2.0624       1.81128      473.258
Watsons K     12.0527      11.8585       11.8202      11.5297      11.5432      10.7959
MeABP         288.008      391.967       409.693      490.597      469.621      949.26

             GASOLINE

LEADED REGULAR,BPCD          4915
TEL Addition,cc/IG: 1.24
RON / MON / (R+M)/2 (Clear)  88.4257 / 83.0072 / 85.7165
RON / MON / (R+M)/2          93.3037 / 87.2714 / 90.2876
RVP,psia                     12.7507

MMT Addition,mg/l: 0
UNLEADED REGULAR,BPCD        34083
RON / MON / (R+M)/2          94.0016 / 84.0638 / 89.0327
RVP,psia                     10.2205

UNLEADED PREMIUM,BPCD        2956
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RON / MON / (R+M)/2            96.85 / 86.8178 / 91.8339
RVP,psia                       9.86704

AVIATION GASOLINE,BPCD         0
RON / MON / (R+M)/2            93 / 90.8 / 91.9
RVP,psia                       10
```

STREAMS

```
< 0 > CRUDE FEED= 136370                     < 1 > REDUCED CRUDE= 62036.6
< 2 > OVERHEAD= 8689.26                      < 3 > NAPHTHA= 11533.6
< 4 > KEROSENE= 37089.2                      < 5 > LGO= 17021.4
< 6 > HVGO= 43928                            < 7 > RESIDUUM= 18108.6
< 8 > FCCU FEED= 43865                       < 9 > REFORMER FEED= 8900
< 10 > CAT POLY FEED= 9155.64                < 11 > ALKYLATION FEED= 0
< 12 > LCO= 10282                            < 13 > HCO= 2570.49
< 14 > CRACKED GAS= 22514.8                  < 15 > POLYMER= 3734.57
< 16 > LE FROM POLY (FOE)= 2876.22           < 17 > REFORMATE= 6716.57
< 18 > LE FROM CAT CRACKER (FOE)= 2906.6     < 19 > FUEL GAS (FOE)= 6183.82
< 20 > I-C4 FR. GAS PLANT= 0                 < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 4915                  < 23 > UNLEADED REGULAR= 34083
< 24 > UNLEADED PREMIUM= 2956                < 25 > AVIATION GASOLINE= 0
< 26 > REFORMATE= 6716.57                    < 27 > NAPHTHA SPECIALTIES= 0
< 28 > LSR= 6495.55                          < 29 > LSR+ISO= 6216.14
< 30 > LSR= 193.71                           < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 62036.6                < 33 > VAC RESID TO ASPHALT PLANT= 9498
< 34 > VAC RESIDUUM= 8610.63                 < 35 > LCO= 2719
< 36 > HVGO TO LUBE OIL= 63                  < 37 > HVGO= 0
< 38 > LCO= 7562.96                          < 39 > C3/C4 -FCCU= 9155.64
< 40 > LGO= 17020.6                          < 41 > LGO= .878174
< 42 > JET FUEL B= 1761                      < 43 > JET FUEL A= 4403
< 44 > STOVE OIL= 2390                       < 45 > LIGHT FUEL OIL= 26607
< 46 > DIESEL FUEL= 27991                    < 47 > HEAVY FUEL OIL= 13901
< 48 > RESID TO COKING= 0                    < 49 > REF C4 TO BLENDING = 2771.88
< 50 > ALKYLATE= 0                           < 51 > CRUDE LIGHT ENDS= 1.60865
< 52 > TOTAL PRODUCT= 129916                 < 53 > C2 % IN CRUDE FEED= .02451
< 54 > C3 % IN CRUDE FEED= .31962            < 55 > I-C4 % IN CRUDE FEED= .19662
< 56 > N-C4 % IN CRUDE FEED= 1.0679          < 57 > LE FROM REFORMER (FOE)= 1997.32
< 58 > NAPHTHA= 1285.58                      < 59 > KEROSENE= 4684.71
< 60 > KEROSENE= 32404.5                     < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 0                     < 63 > LE FROM ALKYL (FOE)= 0
< 64 > HVGO= 43865                           < 65 > LGO = 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 1348      < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                        < 69 > LSR= 6301.84
```

```
                      LIGHT ENDS BALANCE

                         *** FROM ***
             CRUDE UNIT   REFORMER   CAT CRACKER  POLY      ALKYL     ISO       TOTAL
C2   ,#/HR    175.277     1621.09     9288.49     0         0         0          11084.9
C3   ,#/HR    3225.41     4115.26     7905.04     8145.04   0         198.193    23588.9
IC4  ,#/HR    2206.72     2271.15     18519.2     20024     0         352.676    43373.7
NC4  ,#/HR    12410.6     3314.5      7466.27     7466.27   0         1004.25    31661.9
H2   ,#/HR    0           4020.88     3630.57     0         0         0          7651.45
C1   ,#/HR    0           1621.09     3851.32     0         0         0          5472.41
H2S  ,#/HR    0           0           3752.82     0         0         0          3752.82
C2=  ,#/HR    0           0           5663.71     0         0         0          5663.71
C3=  ,#/HR    0           0           18284       0         0         0          18284
C4=  ,#/HR    0           0           28353.2     0         0         0          28353.2
TOTAL  ,#/HR  18018       16964       106715      35635.3   0         1555.12    178887
BPCD (FOE)    1455.59     1997.32     8850.87     2876.21   0         125.43     15305.4

                         *** TO ***
             POLY         ALKY        GAS BLEND   PC FEED   DDS       FUEL GAS   TOTAL
C2   ,#/HR    0           0           0           0         0         11084.9    11084.9
C3   ,#/HR    6640.23     0           0           0         0         16948.7    23588.9
IC4  ,#/HR    18519.2     0           11758.3     0         0         13096.2    43373.7
NC4  ,#/HR    7466.27     0           11446.5     0         0         12749.1    31661.9
H2   ,#/HR    0           0           0           0         5460.55   2190.9     7651.45
C1   ,#/HR    0           0           0           0         0         5472.41    5472.41
H2S  ,#/HR    0           0           0           0         0         3752.82    3752.82
C2=  ,#/HR    0           0           0           0         0         5663.71    5663.71
C3=  ,#/HR    14261.5     0           0           0         0         4022.5     18284
C4=  ,#/HR    28353.2     0           0           0         0         0          28353.2
TOTAL  ,#/HR  75240.4     0           23204.8     0         5460.55   74981.3    178887
BPCD (FOE)    5995.1      0           1866.21     0         1260.29   6183.82    15305.4
```

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                              **** OVERALL MASS BALANCE ****
*** FEED ***

                              BPCD                     #/HR

CRUDE                          136370                   1.723E+06
BUTANE                        0                        0
TOTAL                         136370                   1.723E+06


*** PRODUCT ***

FUEL GAS (FOE)                 6183.82                  74981.3
MOTOR GASOLINE                 41954                    445067
AVIATION TURBO FUELS           6164                     70593.9
DISTILLATES                    56988                    703389
HEAVY FUEL OIL                 13901                    210286
OTHER PRODUCTS                 10909                    161206
H2 TO DESULFURIZERS (FOE)      1260.29                  5460.55
COKE (FOE)                     2775.2                   52106.7
TOTAL                          140135                   1.72309E+06
```

```
TIME:16.06.50 DATE:FRIAPR271984118 44
        REFINERY SIMULATION PROGRAM
       CASE:QUEBAS11 REGION:QUEBEC
        **** FEED BLEND ****
         CRUDE ORIGIN                LV %          BPCD
          FRONTIER                   16.8          46487.3
          VENEZH                     11.65         32236.7
          ARABH                      6.95          19231.3
          CANDNH                     27.3          75541.8
          SYNCRUDE                   16.3          45103.7
          MEXH                       11.6          32098.4
          CONDENSA                   9.4           26010.7
          No.  MBP               LV %       S.G.        API            SULFUR WT%  BPCD          Lbs/hr FEED      Lbs/hr SULFUR
           Total                 100                                               276710           3.5649E+06       64367.1
           Average                         .884407     28.4943        1.80558

            **** MATERIAL BALANCE ****

                      CRUDE UNIT
     No. Name            BPCD        Lbs/hr         IBP        EBP        S.G.        API            SULFUR WT%  Lbs/hr Su
                     *** FEED ***
     0   CRUDE FEED   276710      3.5649E+06     60          1460       .884407     28.4941         1.80558      64367.1
                     *** PRODUCT ***
     2   OVERHEAD     23913.4     223597         60          169.859    .641881     88.9458         .0405305     90.625
     20  LSR          18819.3     181663         60          169.859    .662662     82.0327         .0498626     90.5817
     3   NAPTHA       36181.3     390184         169.859     319.302    .740313     59.6354         .0841478     328.331
     4   KEROSENE     50276.8     605492         319.302     540        .826744     39.6534         .423732      2565.67
     5   LGO          32263.4     415907         540         660        .884944     28.3971         1.02294      4254.48
     1   REDUCED CRUDE 134075     1.92972E+06    660         1460       .988044     11.7123         2.96043      57128

                      VACUUM UNIT
     No. Name            BPCD        Lbs/hr         IBP        EBP        S.G.        API            SULFUR WT%  Lbs/hr Su
                     *** FEED ***
     32  REDUCED CRUDE 134075     1.92972E+06    660         1460       .988044     11.7123         2.96043      57128
                     *** PRODUCT ***
     6   HVGO         86841.8     1.19016E+06    660         1050       .940819     18.9009         1.9963       23759.1
     7   RESIDUUM     47233.4     739563         1050        1460       1.07487     .143829         4.51195      33368.7

                      CAT CRACKER
     No. Name            BPCD        Lbs/hr         IBP        EBP        S.G.        API            SULFUR WT%  Lbs/hr Su
                     *** FEED ***
     65  LGO          9979.2      128642         540         660        .884944     28.3971         1.02294      1315.93
     64  HVGO         80740.8     1.10655E+06    660         1050       .940819     18.9009         1.9963       22090
                     *** TOTAL FEED ***
     8   FCCU FEED    90720       1.23519E+06    540         1050       .934673     19.8898         1.89493      23405.9
                     *** PRODUCT ***
     12  LCO          16765.1     243603         430         650        .997483     10.357          2.93314      7145.2
     13  HCO          4191.26     66642.7        650         750.404    1.08826     -1.47594        4.63436      3079.2
     14  CRACKED GAS  47262.8     517852                                .75217      56.6224         .216429      1120.78
     39  C3/C4 -FCCU  20520       169252                                .566222     118.402         0            0
    *** PRODUCT ***
     < 18 > LE FROM CAT CRACKER (FOE)= 7962.08
     AVAILABLE C3/C4 OLEFINS= 20520
     CONVERSION Wt%= 74.899       CONVERSION Vol %= 76.9
     COKE, WT% 12.2899
     COKE  ,#/HR 151882           Sulfur in Flue Gas,Lbs/hr= 1177.42
```

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                 CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 18400
*** PRODUCT ***
< 15 > POLYMER= 7403.5
< 16 > LE FROM POLY (FOE)= 5913.05

                 ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 3051.58
< 62 > C3/C4 TO ALKYL= 2119.98
< 20 > I-C4 FR. GAS PLANT= 931.599
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 2155.28
< 63 > LE FROM ALKYL (FOE)= 285.143

                 CATALYTIC REFORMER UNIT
No. Name            BPCD          Lbs/hr          IBP          EBP          S.G.        API            SULFUR WT%  Lbs/hr Su
                 *** FEED ***
9   REFORMER FEED 32800          353720          169.859      319.302      .740313     59.6354          0           0
                 *** PRODUCT ***
17  REFORMATE       26045.6       300844                                    .792935     46.951           0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 6144.31
CONVERSION(LV%)= 79.4073    Severity (RON Clear)= 96    FEED KW= 12.0554

                 GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 23913.4
< 57 > LE FROM REFORMER (FOE)= 6144.31
< 18 > LE FROM CAT CRACKER (FOE)= 7962.08
< 16 > LE FROM POLY (FOE)= 5913.05
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 17792.3
< 20 > I-C4 FR. GAS PLANT= 931.599
< 49 > REF C4 TO BLENDING = 5376.73
< 69 > LSR= 18424.9

                 ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 18424.9
*** PRODUCT ***
< 29 > LSR+ISO= 18189.1

*** BY-PASS= 20 %   ***

                 GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 18189.1
< 26 > REFORMATE= 8496.65
< 50 > ALKYLATE= 2155.28
< 15 > POLYMER= 7403.5
< 14 > CRACKED GAS= 47262.8
< 49 > REF C4 TO BLENDING = 5376.73
< 68 > IMPORTED C4= 0
*** PRODUCT ***
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```
      < 22 > LEADED REGULAR= 26456
      < 23 > UNLEADED REGULAR= 53805
      < 24 > UNLEADED PREMIUM= 7925
      < 25 > AVIATION GASOLINE= 698

      *** GASOLINE COMPOSITION ***

                 LR          UR           UP          AV

LSR          .297393     .192253      0           0
CRACKED GAS  .647564     .56          0           0
REFORMATE    0           .0365192     .824193     0
POLYMER      0           .137599      0           0
ALKYLATE     0           .0111542     .11         .9786
C4           .055043     .0624744     .0658068    .0214

                     TURBO FUEL BLENDING
      *** FEED ***
      < 30 > LSR= 394.35
      < 58 > NAPHTHA= 3381.3
      < 59 > KEROSENE= 10942.4
      *** PRODUCT ***
      < 42 > JET FUEL B= 3585
      < 43 > JET FUEL A= 11133

      *** TURBO FUEL COMPOSITION ***

                     NAPHTHA BASE  KEROSENE BASE

      LSR              .11           0
      NAPHTHA          .555          .125
      KEROSENE         .335          .875

                     DISTILLATE BLENDING
      *** FEED ***
      < 60 > KEROSENE= 39334.5
      < 40 > LGO= 14334.8
      < 38 > LCO= 4765.05
      *** PRODUCT ***
      < 44 > STOVE OIL= 1384
      < 45 > LIGHT FUEL OIL= 20505
      < 46 > DIESEL FUEL= 36545

      *** DISTILLATE COMPOSITION ***

                     STOVE OIL     DIESEL FUEL   LFO

      KEROSENE         1             .7            .603202
      LCO              0             0             .232385
      LGO              0             .3            .164413

                     HEAVY FUEL OIL BLENDING
      *** FEED ***
      < 41 > LGO= 7949.38
      < 35 > LCO= 12000
      < 13 > ECO= 4191.26
      < 37 > HVGO= 0
      < 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 31760.4
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 55901

              OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 17549
< 36 > HVGO TO LUBE OIL= 3774
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 15473
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 0
< 67 > VGO PETROCHEMICAL FEED= 2327

                        DISTILLATE DESULFURIZATION

STREAM              TOTAL                 FEED  TO  DDS                                      FINAL STREAM
                    BPCD        BPCD        Lbs/hr     SULFUR WT%         % BYPASS          SULFUR WT%
KEROSENE            50276.8     50276.8     605492     .423732            0                 .0212722
LGO                 22284.2     22284.2     287265     1.02294            8.76462E-06       .103245
LCO                 16765.1     13412       194881     2.93314            20.0005           .839011
HCO                 4191.26     0           0          4.63436            100               4.63436
VAC RESIDUUM        31760.4     0           0          4.51195            100               4.51195


  ***PRODUCT SLATES & SPECIFICATIONS***

                 JET FUEL B    JET FUEL A    STOVE OIL    LFO          DIESEL FUEL   HFO

BPCD             3585          11133         1384         20505        36545         55901
S.G.             .760726       .81594        .826744      .87599       .844204       1.03225
ASTM 10%         207.052       333.141       381.341      397.911      393.082
ASTM 20%         225.682       359.489       394.638      425.011      416.516
ASTM 50%         281.819       424.61        439.978      488.006      484.452
ASTM 90%         470.134       499.671       502.781      597.645      603.436
RVP,psia         2.81866
Sulfur Wt %      .0579402      .0283273      .0211866     .246375      .046693       3.21846
Flash Point,F    64.5252       127.194       143.889      152.871      150.182
Pour Point,F     -85.1373      -50.4689      -44.772      -54.8607     -29.7012
Cetane No.                                                             45.5979
Visc @100F,cs    .798432       1.50952       1.72476      2.43087      2.28809       613.629
Visc @122F,cs    .703911       1.29245       1.4659       2.01237      1.91356       260.729
Watsons K        11.9521       11.7112       11.6551      11.1909      11.6012       10.7823
MeABP            291.661       412.526       434.662      482.094      479.399       918.88

                 GASOLINE

LEADED REGULAR,BPCD            26456
TEL Addition,cc/IG: 1.24
RON / MON / (R+M)/2 (Clear)    90.515 / 82.0132 / 86.2641
RON / MON / (R+M)/2            94.5367 / 85.1819 / 89.8593
RVP,psia                       11.5938

MMT Addition,mg/l: 18
UNLEADED REGULAR,BPCD          53805
RON / MON / (R+M)/2            93.9841 / 84.141 / 89.0626
RVP,psia                       10.9893
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UNLEADED PREMIUM,BPCD        7925
RON / MON / (R+M)/2          96.6484 / 87.0631 / 91.8558
RVP,psia                     9.80441

AVIATION GASOLINE,BPCD       698
RON / MON / (R+M)/2          93 / 90.8 / 91.9
RVP,psia                     10
```

STREAMS

```
< 0 > CRUDE FEED= 276710                         < 1 > REDUCED CRUDE= 134075
< 2 > OVERHEAD= 23913.4                          < 3 > NAPHTHA= 36181.3
< 4 > KEROSENE= 50276.8                          < 5 > LGO= 32263.4
< 6 > HVGO= 86841.8                              < 7 > RESIDUUM= 47233.4
< 8 > FCCU FEED= 90720                           < 9 > REFORMER FEED= 32800
< 10 > CAT POLY FEED= 18400                      < 11 > ALKYLATION FEED= 3051.58
< 12 > LCO= 16765.1                              < 13 > HCO= 4191.26
< 14 > CRACKED GAS= 47262.8                      < 15 > POLYMER= 7403.5
< 16 > LE FROM POLY (FOE)= 5913.05               < 17 > REFORMATE= 26045.6
< 18 > LE FROM CAT CRACKER (FOE)= 7962.08        < 19 > FUEL GAS (FOE)= 17792.3
< 20 > I-C4 FR. GAS PLANT= 931.599               < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 26456                     < 23 > UNLEADED REGULAR= 53805
< 24 > UNLEADED PREMIUM= 7925                    < 25 > AVIATION GASOLINE= 698
< 26 > REFORMATE= 8496.65                        < 27 > NAPHTHA SPECIALTIES= 17549
< 28 > LSR= 18819.3                              < 29 > LSR+ISO= 18189.1
< 30 > LSR= 394.35                               < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 134075                     < 33 > VAC RESID TO ASPHALT PLANT= 15473
< 34 > VAC RESIDUUM= 31760.4                     < 35 > LCO= 12000
< 36 > HVGO TO LUBE OIL= 3774                    < 37 > HVGO= 0
< 38 > LCO= 4765.05                              < 39 > C3/C4 -FCCU= 20520
< 40 > LGO= 14334.8                              < 41 > LGO= 7949.38
< 42 > JET FUEL B= 3585                          < 43 > JET FUEL A= 11133
< 44 > STOVE OIL= 1384                           < 45 > LIGHT FUEL OIL= 20505
< 46 > DIESEL FUEL= 36545                        < 47 > HEAVY FUEL OIL= 55901
< 48 > RESID TO COKING= 0                        < 49 > REF C4 TO BLENDING = 5376.73
< 50 > ALKYLATE= 2155.28                         < 51 > CRUDE LIGHT ENDS= 1.84108
< 52 > TOTAL PRODUCT= 257060                     < 53 > C2 % IN CRUDE FEED= .04423
< 54 > C3 % IN CRUDE FEED= .277635               < 55 > I-C4 % IN CRUDE FEED= .21544
< 56 > N-C4 % IN CRUDE FEED= 1.30377             < 57 > LE FROM REFORMER (FOE)= 6144.31
< 58 > NAPHTHA= 3381.3                           < 59 > KEROSENE= 10942.4
< 60 > KEROSENE= 39334.5                         < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 2119.98                   < 63 > LE FROM ALKYL (FOE)= 285.143
< 64 > HVGO= 80740.8                             < 65 > LGO = 9979.2
< 66 > NAPHTHA PETROCHEMICAL FEED= 0             < 67 > VGO PETROCHEMICAL FEED= 2327
< 68 > IMPORTED C4= 0                            < 69 > LSR= 18424.9
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                                  LIGHT ENDS BALANCE

                                    *** FROM ***
                CRUDE UNIT     REFORMER       CAT CRACKER    POLY           ALKYL          ISO            TOTAL
C2   ,#/HR       641.807        4764.46        26606.7        0              0              0              32013
C3   ,#/HR       5685.01        12575.6        18567.4        17020.6        1611.33        545.378        56005.3
IC4   ,#/HR      4906.27        7623.52        40908.7        39717.6        0              970.477        94126.6
NC4   ,#/HR      30744.5        11125.7        18416.4        16513.8        1902.65        2763.44        81466.5
H2   ,#/HR       0              12021.6        10351.8        0              0              0              22373.4
C1   ,#/HR       0              4764.46        11032          0              0              0              15796.5
H2S   ,#/HR      0              0              11563.5        0              0              0              11563.5
C2=   ,#/HR      0              0              16223.6        0              0              0              16223.6
C3=   ,#/HR      0              0              34629.6        0              0              0              34629.6
C4=   ,#/HR      0              0              67319.2        0              0              0              67319.2
TOTAL   ,#/HR    41977.6        52875.3        255619         73252          3513.98        4279.3         431517
BPCD (FOE)       3389.7         6144.3         21290.7        5913.05        285.143        345.151        37368

                                    *** TO ***
                POLY           ALKY           GAS  BLEND     PC  FEED       DDS            FUEL GAS       TOTAL
C2   ,#/HR       0              0              0              0              0              32013          32013
C3   ,#/HR       13985.3        1611.33        0              0              0              40408.7        56005.3
IC4   ,#/HR      36682.3        11893.5        18936.8        0              0              26614.1        94126.6
NC4   ,#/HR      16513.7        1902.65        26211.8        0              0              36838.3        81466.5
H2   ,#/HR       0              0              0              0              7984.64        14388.8        22373.4
C1   ,#/HR       0              0              0              0              0              15796.5        15796.5
H2S   ,#/HR      0              0              0              0              0              11563.5        11563.5
C2=   ,#/HR      0              0              0              0              0              16223.6        16223.6
C3=   ,#/HR      24220.5        2790.59        0              0              0              7618.53        34629.6
C4=   ,#/HR      60364.2        6954.94        0              0              0              0              67319.2
TOTAL   ,#/HR    151766         25153          45148.6        0              7984.64        201465         431517
BPCD (FOE)       12092          2008.94        3631.91        0              1842.86        17792.3        37368
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                              **** OVERALL MASS BALANCE ****
*** FEED ***

                              BPCD                      #/HR

CRUDE                          276710                    3.5649E+06
BUTANE                         0                         0
TOTAL                          276710                    3.5649E+06


*** PRODUCT ***

FUEL GAS (FOE)                 17792.3                   201465
MOTOR GASOLINE                 88884                     934872
AVIATION TURBO FUELS           14718                     172052
DISTILLATES                    58434                     727736
HEAVY FUEL OIL                 55901                     840571
OTHER PRODUCTS                 39123                     528587
H2 TO DESULFURIZERS (FOE)      1842.86                   7984.64
COKE (FOE)                     8089.24                   151882
TOTAL                          284784                    3.56515E+06
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TIME:16.29.16 DATE:FRIAPR271984118 44
         REFINERY SIMULATION PROGRAM
        CASE:QUEBAS10 REGION:QUEBEC
         **** FEED BLEND ****
           CRUDE ORIGIN                LV %          BPCD
            FRONTIER                   16.8         46601.4
            VENEZH                     11.65        32315.9
            ARABH                      6.95         19278.6
            CANDNH                     27.3         75727.3
            SYNCRUDE                   16.3         45214.5
            MEXH                       11.6         32177.2
            CONDENSA                   9.4          26074.6
            No.  MBP              LV %     S.G.        API          SULFUR WT%  BPCD        Lbs/hr FEED     Lbs/hr SULFUR
             Total                100                                          277390        3.57365E+06    64525.1
             Average                     .884407     28.4942         1.80558

              **** MATERIAL BALANCE ****

                            CRUDE UNIT
            No. Name          BPCD        Lbs/hr         IBP          EBP          S.G.        API           SULFUR WT%  Lbs/hr Su
                           *** FEED ***
            0   CRUDE FEED    277389      3.57365E+06    60           1460         .884408     28.494          1.80558      64525.1
                           *** PRODUCT ***
            2   OVERHEAD      23944.3     223862         60           169.73       .641812     88.9696         .0405332     90.7383
            28  LSR           18837.7     181824         60           169.73       .662603     82.0517         .0498571     90.6522
            3   NAPHTHA       35281.3     391240         169.73       319.234      .74027      59.6465         .0841091     329.068
            4   KEROSENE      50416.9     607166         319.234      540          .826725     39.6573         .423638      2572.19
            5   LGO           32342.6     416928         540          660          .884944     28.3971         1.02294      4264.92
            1   REDUCED CRUDE 134404      1.93445E+06    660          1460         .988044     11.7123         2.96043      57268.2

                            VACUUM UNIT
            No. Name          BPCD        Lbs/hr         IBP          EBP          S.G.        API           SULFUR WT%  Lbs/hr Su
                           *** FEED ***
            32  REDUCED CRUDE 134404      1.93445E+06    660          1460         .988044     11.7123         2.96043      57268.2
                           *** PRODUCT ***
            6   HVGO          87055.4     1.19309E+06    660          1050         .940819     18.9009         1.9963       23817.6
            7   RESIDUUM      47348.9     741372         1050         1460         1.07487     .143829         4.51195      33450.3

                            CAT CRACKER
            No. Name          BPCD        Lbs/hr         IBP          EBP          S.G.        API           SULFUR WT%  Lbs/hr Su
                           *** FEED ***
            65  LGO           10005.6     128982         540          660          .884944     28.3971         1.02294      1319.41
            64  HVGO          80954.4     1.10947E+06    660          1050         .940819     18.9009         1.9963       22148.4
                           *** TOTAL FEED ***
            8   FCCU FEED     90960       1.23846E+06    540          1050         .934673     19.8898         1.89493      23467.8
                           *** PRODUCT ***
            12  LCO           16518.3     240135         430          650          .997975     10.2871         2.96913      7129.92
            13  HCO           4129.58     65534.1        650          748.726      1.08941     -1.61317        4.69123      3074.36
            14  CRACKED GAS   47509.4     520842                                   .752587     56.5181         .214673      1118.11
            39  C3/C4 -FCCU   20713.6     170851                                   .566229     118.399         0            0
           *** PRODUCT ***
           < 18 > LE FROM CAT CRACKER (FOE)= 8084.66
           AVAILABLE C3/C4 OLEFINS= 20713.6
           CONVERSION Wt%= 75.3185     CONVERSION Vol %= 77.3
           COKE, WT% 12.4059
           COKE  ,#/HR 153721          Sulfur in Flue Gas,Lbs/hr= 1190.14
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                 CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 18600
*** PRODUCT ***
< 15 > POLYMER= 7483.67
< 16 > LE FROM POLY (FOE)= 5977.75

                 ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 3042.22
< 62 > C3/C4 TO ALKYL= 2113.6
< 20 > I-C4 FR. GAS PLANT= 928.623
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 2148.66
< 63 > LE FROM ALKYL (FOE)= 284.297

                 CATALYTIC REFORMER UNIT
 No. Name          BPCD        Lbs/hr          IBP         EBP         S.G.        API          SULFUR WT%  Lbs/hr Su
                 *** FEED ***
 9   REFORMER FEED 32900       354778          169.73      319.234     .74027     59.6465        0           0
                 *** PRODUCT ***
 17  REFORMATE     25761.6     298756                                  .79611     46.2392        0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 6539.65
CONVERSION(LV%)= 78.3027    Severity (RON Clear)= 97    FEED KW= 12.0555

                 GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 23944.3
< 57 > LE FROM REFORMER (FOE)= 6539.65
< 18 > LE FROM CAT CRACKER (FOE)= 8084.66
< 16 > LE FROM POLY (FOE)= 5977.75
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 18470.4
< 20 > I-C4 FR. GAS PLANT= 928.623
< 49 > REF C4 TO BLENDING = 5381.5
< 69 > LSR= 18443.3

                 ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 18443.3
*** PRODUCT ***
< 29 > LSR+ISO= 18148.2

*** BY-PASS= 0 %   ***

                 GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 18148.2
< 26 > REFORMATE= 8212.57
< 50 > ALKYLATE= 2148.66
< 15 > POLYMER= 7483.67
< 14 > CRACKED GAS= 47509.4
< 49 > REF C4 TO BLENDING = 5381.5
< 68 > IMPORTED C4= 0
*** PRODUCT ***
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< 22 > LEADED REGULAR= 8820
< 23 > UNLEADED REGULAR= 71441
< 24 > UNLEADED PREMIUM= 7925
< 25 > AVIATION GASOLINE= 698

*** GASOLINE COMPOSITION ***

               LR           UR           UP           AV

LSR            .252852      .22284       0            0
CRACKED GAS    .688616      .58          0            0
REFORMATE      0            .014363      .90681       0
POLYMER        0            .104753      0            0
ALKYLATE       0            .0182918     .02          .9786
C4             .0585324     .0597518     .0731903     .0214

                   TURBO FUEL BLENDING
*** FEED ***
< 30 > LSR= 394.35
< 58 > NAPHTHA= 3381.3
< 59 > KEROSENE= 10942.4
*** PRODUCT ***
< 42 > JET FUEL B= 3585
< 43 > JET FUEL A= 11133

*** TURBO FUEL COMPOSITION ***

               NAPHTHA BASE  KEROSENE BASE

LSR             .11           0
NAPHTHA         .555          .125
KEROSENE        .335          .875

               DISTILLATE BLENDING
*** FEED ***
< 60 > KEROSENE= 39474.5
< 40 > LGO= 18441.5
< 38 > LCO= 518.332
*** PRODUCT ***
< 44 > STOVE OIL= 1384
< 45 > LIGHT FUEL OIL= 20505
< 46 > DIESEL FUEL= 36545

*** DISTILLATE COMPOSITION ***

               STOVE OIL     DIESEL FUEL   LFO

KEROSENE        1             .7            .610033
LCO             0             0             .0252783
LGO             0             .3            .364689

               HEAVY FUEL OIL BLENDING
*** FEED ***
< 41 > LGO= 3895.52
< 35 > LCO= 16000
< 13 > HCO= 4129.58
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 31875.9
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 55901

              OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 17549
< 36 > HVGO TO LUBE OIL= 3774
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 15473
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 0
< 67 > VGO PETROCHEMICAL FEED= 2327

                           DISTILLATE DESULFURIZATION

STREAM                 TOTAL             FEED  TO  DDS                                      FINAL STREAM
                       BPCD       BPCD       Lbs/hr     SULFUR WT%             % BYPASS     SULFUR WT%
KEROSENE               50416.9     50416.9   607166      .423638               0            .0212675
LGO                    22337       22337     287946     1.02294                0            .103245
LCO                    16518.3     13214.7   192109     2.96913                19.9996      .849507
HCO                    4129.58     0         0          4.69123                100          4.69123
VAC RESIDUUM           31875.9     0         0          4.51195                100          4.51195


   ***PRODUCT SLATES & SPECIFICATIONS***

               JET FUEL B   JET FUEL A   STOVE OIL    LFO          DIESEL FUEL   HFO

BPCD           3585         11133        1384         20505        36545         55901
S.G.           .760689      .815918      .826725      .852286      .844191       1.0407
ASTM 10%       206.983      333.063      381.275      397.202      393.014
ASTM 20%       225.599      359.421      394.578      425.053      416.458
ASTM 50%       281.742      424.562      439.942      502.763      484.434
ASTM 90%       470.114      499.663      502.774      608.753      603.437
RVP,psia       2.93185
Sulfur Wt %    .0579166     .0283185     .0211819     .0758767     .0466901      3.2543
Flash Point,F  64.487       127.151      143.852      152.496      150.145
Pour Point,F   -85.155      -50.4827     -44.7829     -27.6283     -29.7114
Cetane No.                                                         45.6002
Visc @100F,cs  .798158      1.5091       1.72434      2.51015      2.28761       627.833
Visc @122F,cs  .703679      1.29211      1.46557      2.08615      1.91318       261.743
Watsons K      11.9523      11.7113      11.6552      11.5448      11.6012       10.685
MeABP          291.589      412.479      434.622      492.627      479.368       915.08

               GASOLINE

LEADED REGULAR,BPCD          8820
TEL Addition,cc/IG: 1.24
RON / MON / (R+M)/2 (Clear)  92.9224 / 84.4627 / 88.6926
RON / MON / (R+M)/2          96.6952 / 87.4263 / 92.0608
RVP,psia                     11.5212

MMT Addition,mg/l: 0
UNLEADED REGULAR,BPCD        71441
RON / MON / (R+M)/2          93.3494 / 84.5419 / 88.9457
RVP,psia                     11.3514
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UNLEADED PREMIUM,BPCD        7925
RON / MON / (R+M)/2          96.7125 / 86.9379 / 91.8252
RVP,psia                     9.80434

AVIATION GASOLINE,BPCD       698
RON / MON / (R+M)/2          93 / 90.8 / 91.9
RVP,psia                     10



                         STREAMS

< 0 > CRUDE FEED= 277389                      < 1 > REDUCED CRUDE= 134404
< 2 > OVERHEAD= 23944.3                       < 3 > NAPHTHA= 36281.3
< 4 > KEROSENE= 50416.9                       < 5 > LGO= 32342.6
< 6 > HVGC= 87055.4                           < 7 > RESIDUUM= 47348.9
< 8 > FCCU FEED= 90960                        < 9 > REFORMER FEED= 32900
< 10 > CAT POLY FEED= 18600                   < 11 > ALKYLATION FEED= 3042.22
< 12 > LCO= 16518.3                           < 13 > HCO= 4129.58
< 14 > CRACKED GAS= 47509.4                   < 15 > POLYMER= 7483.67
< 16 > LE FROM POLY (FOE)= 5977.75            < 17 > REFORMATE= 25761.6
< 18 > LE FROM CAT CRACKER (FOE)= 8084.66     < 19 > FUEL GAS (FOE)= 18470.4
< 20 > I-C4 FR. GAS PLANT= 928.623            < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 8820                   < 23 > UNLEADED REGULAR= 71441
< 24 > UNLEADED PREMIUM= 7925                 < 25 > AVIATION GASOLINE= 698
< 26 > REFORMATE= 8212.57                     < 27 > NAPHTHA SPECIALTIES= 17549
< 28 > LSR= 18837.7                           < 29 > LSR+ISO= 18148.2
< 30 > LSR= 394.35                            < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 134404                  < 33 > VAC RESID TO ASPHALT PLANT= 15473
< 34 > VAC RESIDUUM= 31875.9                  < 35 > LCO= 16000
< 36 > HVGO TO LUBE OIL= 3774                 < 37 > HVGO= 0
< 38 > LCO= 518.332                           < 39 > C3/C4 -FCCU= 20713.6
< 40 > LGO= 18441.5                           < 41 > LGO= 3895.52
< 42 > JET FUEL B= 3585                       < 43 > JET FUEL A= 11133
< 44 > STOVE OIL= 1384                        < 45 > LIGHT FUEL OIL= 20505
< 46 > DIESEL FUEL= 36545                     < 47 > HEAVY FUEL OIL= 55901
< 48 > RESID TO COKING= 0                     < 49 > REF C4 TO BLENDING = 5381.5
< 50 > ALKYLATE= 2148.66                      < 51 > CRUDE LIGHT ENDS= 1.84108
< 52 > TOTAL PRODUCT= 257060                  < 53 > C2 % IN CRUDE FEED= .04423
< 54 > C3 % IN CRUDE FEED= .277635            < 55 > I-C4 % IN CRUDE FEED= .21544
< 56 > N-C4 % IN CRUDE FEED= 1.30377          < 57 > LE FROM REFORMER (FOE)= 6539.65
< 58 > NAPHTHA= 3381.3                        < 59 > KEROSENE= 10942.4
< 60 > KEROSENE= 39474.5                      < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 2113.6                 < 63 > LE FROM ALKYL (FOE)= 284.297
< 64 > HVGO= 80954.4                          < 65 > LGO = 10005.6
< 66 > NAPHTHA PETROCHEMICAL FEED= 0          < 67 > VGO PETROCHEMICAL FEED= 2327
< 68 > IMPORTED C4= 0                         < 69 > LSR= 18443.3
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                          LIGHT ENDS BALANCE

                            *** FROM ***
              CRUDE UNIT    REFORMER     CAT CRACKER   POLY        ALKYL       ISO         TOTAL
C2   ,#/HR     643.383      5151.26      27036.9       0           0           0           32831.5
C3   ,#/HR     5698.96      13423.8      18760         17218.8     1607.97     682.403     57391.9
IC4   ,#/HR    4918.31      7876.44      41299.1       40153.3     0           1214.31     95461.5
NC4   ,#/HR    30820        11494.8      18576.8       16681.2     1895.56     3457.75     82926.1
H2   ,#/HR     0            12924.3      10525.7       0           0           0           23450
C1   ,#/HR     0            5151.26      11210.4       0           0           0           16361.7
H2S   ,#/HR    0            0            11640         0           0           0           11640
C2=   ,#/HR    0            0            16485.9       0           0           0           16485.9
C3=   ,#/HR    0            0            34917.2       0           0           0           34917.2
C4=   ,#/HR    0            0            67981.4       0           0           0           67981.4
TOTAL   ,#/HR  42080.7      56021.9      258433        74053.3     3503.53     5354.46     439447
BPCD (FOE)     3398.03      6539.66      21539.6       5977.75     284.297     431.87      38171.2

                            *** TO ***
              POLY          ALKY         GAS BLEND     PC FEED     DDS         FUEL GAS    TOTAL
C2   ,#/HR     0            0            0             0           0           32831.5     32831.5
C3   ,#/HR     14150.4      1607.98      0             0           0           41633.5     57391.9
IC4   ,#/HR    37085        11856.7      18960.7       0           0           27559.1     95461.5
NC4   ,#/HR    16681.2      1895.56      26227.7       0           0           38121.6     82926.1
H2   ,#/HR     0            0            0             0           7969.08     15480.9     23450
C1   ,#/HR     0            0            0             0           0           16361.7     16361.7
H2S   ,#/HR    0            0            0             0           0           11640       11640
C2=   ,#/HR    0            0            0             0           0           16485.9     16485.9
C3=   ,#/HR    24456.3      2779.08      0             0           0           7681.8      34917.2
C4=   ,#/HR    61044.6      6936.77      0             0           0           0           67981.4
TOTAL   ,#/HR  153418       25076.1      45188.4       0           7969.08     207796      439447
BPCD (FOE)     12223.6      2002.8       3635.11       0           1839.26     18470.4     38171.2
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                              **** OVERALL MASS BALANCE ****
*** FEED ***

                              BPCD                        #/HR

CRUDE                         277389                      3.57365E+06
BUTANE                        0                           0
TOTAL                         277389                      3.57365E+06


*** PRODUCT ***

FUEL GAS (FOE)                18470.4                     207796
MOTOR GASOLINE                88884                       934871
AVIATION TURBO FUELS          14718                       172046
DISTILLATES                   58434                       720648
HEAVY FUEL OIL                55901                       847452
OTHER PRODUCTS                39123                       529399
H2 TO DESULFURIZERS (FOE)     1839.26                     7969.08
COKE (FOE)                    8187.18                     153721
TOTAL                         285557                      3.5739E+06
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TIME:13.41.09 DATE:MONAPR301984121 40
        REFINERY SIMULATION PROGRAM
        CASE:ONTBAS11 REGION:ONTARIO
         **** FEED BLEND ****
           CRUDE ORIGIN                 LV %           BPCD
            CANDWL                      49             219127
            CANDWH                      9.2            41142.1
            SYNCRUDE                    30.8           137737
            CONDENSA                    11             49191.7
             No.  MBP            LV %      S.G.        API            SULFUR WT%  BPCD          Lbs/hr FEED      Lbs/hr SULFUR
              Total              100                                              447197          5.47841E+06     26424.8
              Average                     .84098       36.7562        .482344

              **** MATERIAL BALANCE ****

                          CRUDE UNIT
            No. Name           BPCD        Lbs/hr         IBP         EBP         S.G.       API           SULFUR WT%  Lbs/hr Su
                           *** FEED ***
            0   CRUDE FEED     447197      5.47841E+06    60          1300        .84098     36.7561        .482344     26424.8
                           *** PRODUCT ***
            2   OVERHEAD       54291.6     507241         60          170.084     .641374    89.1202        .0289326    146.758
            28  LSR            40941.8     398662         60          170.084     .668448    80.1844        .036801     146.712
            3   NAPHTHA        82650.8     907116         170.084     322.409     .753435    56.3065        .0268925    243.946
            4   KEROSENE       107671      1.30782E+06    322.409     560         .83383     38.1989        .107138     1401.17
            5   LGO            48108.6     618952         560         660         .88321     28.711         .312237     1932.6
            1   REDUCED CRUDE  154475      2.13729E+06    660         1300        .949805    17.478         1.06211     22700.3

                          VACUUM UNIT
            No. Name           BPCD        Lbs/hr         IBP         EBP         S.G.       API           SULFUR WT%  Lbs/hr Su
                           *** FEED ***
            32  REDUCED CRUDE  154475      2.13729E+06    660         1300        .949805    17.478         1.06211     22700.3
                           *** PRODUCT ***
            6   HVGO           123780      1.66446E+06    660         1050        .923111    21.786         .618341     10292.1
            7   RESIDUUM       30695.2     472829         1050        1300        1.05746    2.31122        2.62443     12409.1

                          CAT CRACKER
            No. Name           BPCD        Lbs/hr         IBP         EBP         S.G.       API           SULFUR WT%  Lbs/hr Su
                           *** FEED ***
            65  LGO            29157.1     375127         560         660         .88321     28.711         .312237     1171.29
            64  HVGO           97612.9     1.3126E+06     660         1050        .923111    21.786         .618341     8116.32
                           *** TOTAL FEED ***
            8   FCCU FEED      126770      1.68772E+06    560         1050        .913934    23.3252        .550304     9287.61
                           *** PRODUCT ***
            12  LCO            20283.2     285109         430         650         .964948    15.14          .95225      2714.95
            13  HCO            5070.8      79598.4        650         736.438     1.0776     -.189667       1.50455     1197.6
            14  CRACKED GAS    72322.3     789619                                 .749506    57.291         .0541336    427.449
            39  C3/C4 -FCCU    20095.6     164971                                 .563555    119.585        0           0
            *** PRODUCT ***
            < 18 > LE FROM CAT CRACKER (FOE)= 18722.1
            AVAILABLE C3/C4 OLEFINS= 31593.8
            CONVERSION Wt%= 78.3906      CONVERSION Vol %= 80
            COKE, WT% 9.63115
            COKE  ,#/HR 162631           Sulfur in Flue Gas,Lbs/hr= 496.565

                          CAT POLY UNIT
            *** FEED ***
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< 10 > CAT POLY FEED= 1E-06
*** PRODUCT ***
< 15 > POLYMER= 4.08466E-07
< 16 > LE FROM POLY (FOE)= 3.12969E-07

                ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 29100
< 62 > C3/C4 TO ALKYL= 20095.6
< 20 > I-C4 FR. GAS PLANT= 5954.16
< 21 > I-C4 IMPORTED= 3050.22
*** PRODUCT ***
< 50 > ALKYLATE= 20807.1
< 63 > LE FROM ALKYL (FOE)= 2449.61

                CATALYTIC REFORMER UNIT
No. Name            BPCD       Lbs/hr        IBP        EBP         S.G.       API          SULFUR WT%  Lbs/hr Su
                *** FEED ***
 9   REFORMER FEED 62500       685955        170.084    322.409     .753435    56.3065      0           0
                *** PRODUCT ***
 17  REFORMATE     51094.7     596603                               .801567    45.0293      0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 10294.4
CONVERSION(LV%)= 81.7515    Severity (RON Clear)= 96.5  FEED KW= 11.8529

                GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 54291.6
< 57 > LE FROM REFORMER (FOE)= 10294.4
< 18 > LE FROM CAT CRACKER (FOE)= 18722.1
< 16 > LE FROM POLY (FOE)= 3.12969E-07
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 28045.8
< 20 > I-C4 FR. GAS PLANT= 5954.16
< 49 > REF C4 TO BLENDING = 8888.02
< 69 > LSR= 40471.3

                ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 40471.3
*** PRODUCT ***
< 29 > LSR+ISO= 40179.9

*** BY-PASS= 55 %   ***

                GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 40179.9
< 26 > REFORMATE= 28513.7
< 50 > ALKYLATE= 20807.1
< 15 > POLYMER= 4.08466E-07
< 14 > CRACKED GAS= 72322.3
< 49 > REF C4 TO BLENDING = 8888.02
< 68 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 51175
< 23 > UNLEADED REGULAR= 104062
< 24 > UNLEADED PREMIUM= 15348
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   < 25 > AVIATION GASOLINE= 126

   *** GASOLINE COMPOSITION ***

              LR            UR            UP            AV

LSR          .316064       .230691       0             0
CRACKED GAS  .630356       .305          0             0
REFORMATE    0             .165777       .727033       0
POLYMER      0             3.92521E-12   0             0
ALKYLATE     0             .167791       .21           .9786
C4           .0535803      .0497413      .0629671      .0214

                   TURBO FUEL BLENDING
   *** FEED ***
   < 30 > LSR= 470.47
   < 58 > NAPHTHA= 4865.84
   < 59 > KEROSENE= 18565.7
   *** PRODUCT ***
   < 42 > JET FUEL B= 4277
   < 43 > JET FUEL A= 19625

   *** TURBO FUEL COMPOSITION ***

                 NAPHTHA BASE  KEROSENE BASE

   LSR             .11           0
   NAPHTHA         .61           .115
   KEROSENE        .28           .885

                   DISTILLATE BLENDING
   *** FEED ***
   < 60 > KEROSENE= 89105.3
   < 40 > LGO= 18950.5
   < 38 > LCO= 14410.2
   *** PRODUCT ***
   < 44 > STOVE OIL= 2264
   < 45 > LIGHT FUEL OIL= 38243
   < 46 > DIESEL FUEL= 81959

   *** DISTILLATE COMPOSITION ***

                 STOVE OIL     DIESEL FUEL   LFO

   KEROSENE        1             .68           .813461
   LCO             0             .1            .162495
   LGO             0             .22           .0240436

                   HEAVY FUEL OIL BLENDING
   *** FEED ***
   < 41 > LGO= .99707
   < 35 > LCO= 5873
   < 13 > HCO= 5070.8
   < 37 > HVGO= 0
   < 31 > REDUCED CRUDE= 0
   < 34 > VAC RESIDUUM= 22329.2
   *** PRODUCT ***
   < 47 > HEAVY FUEL OIL= 33274
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            OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 22581
< 36 > HVGO TO LUBE OIL= 10882
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 8366
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285
< 67 > VGO PETROCHEMICAL FEED= 15285

                          DISTILLATE DESULFURIZATION

                                                                                              FINAL STREAM
STREAM            TOTAL                   FEED  TO  DDS                          % BYPASS      SULFUR WT%
                  BPCD          BPCD        Lbs/hr       SULFUR WT%
KEROSENE          107671        107671      1.30782E+06   .107138                0              5.36236E-03
LGO               18951.5       18951.5     243825        .312237                1.03059E-05    .0313117
LCO               20283.2       18254.9     256598        .95225                 9.9999         .182333
HCO               5070.8        0           0             1.50455                100            1.50455
VAC RESIDUUM      22329.2       0           0             2.62443                100            2.62443


  ***PRODUCT SLATES & SPECIFICATIONS***

               JET FUEL B    JET FUEL A     STOVE OIL      LFO            DIESEL FUEL    HFO

BPCD            4277          19625          2264           38243          81959          33274
S.G.            .766597       .824584        .83383         .856323        .857805        1.04419
ASTM 10%        206.691       345.761        385.477        392.019        397.689
ASTM 20%        224.1         369.282        400.281        412.211        423.405
ASTM 50%        273.952       433.187        448.61         468.452        493.805
ASTM 90%        468.602       517.041        519.654        539.158        602.177
RVP,psia        2.6426
Sulfur Wt %     .0212841      7.61981E-03    5.35691E-03    .0381467       .0309661       2.04968
Flash Point,F   64.3719       134.212        144.969        148.411        151.473
Pour Point,F   -95.6193      -50.009        -44.4456       -52.9434       -36.6125
Cetane No.                                                                 41.7016
Visc @100F,cs   .774538       1.62213        1.8335         2.06617        2.42603        1822.77
Visc @122F,cs   .683231       1.3828         1.5522         1.73195        2.01704        637.794
Watsons K       11.8222       11.6394        11.5963        11.3572        11.4435        10.7688
MeABP           284.384       424.091        444.046        459.87         485.89         961.91

              GASOLINE

LEADED REGULAR,BPCD             51175
TEL Addition,cc/IG: 1.24
RON / MON / (R+M)/2 (Clear)     89.6255 / 81.354 / 85.4898
RON / MON / (R+M)/2             94.2635 / 85.3426 / 89.8031
RVP,psia                        11.3809

MMT Addition,mg/l: 18
UNLEADED REGULAR,BPCD           104062
RON / MON / (R+M)/2             92.824 / 85.2032 / 89.0136
RVP,psia                        10.92

UNLEADED PREMIUM,BPCD           15348
RON / MON / (R+M)/2             96.085 / 87.5367 / 91.8109
RVP,psia                        9.74553
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AVIATION GASOLINE,BPCD        126
RON / MON / (R+M)/2           93 / 90.8 / 91.9
RVP,psia                      10



                       STREAMS

< 0 > CRUDE FEED= 447197                    < 1 > REDUCED CRUDE= 154475
< 2 > OVERHEAD= 54291.6                     < 3 > NAPHTHA= 82650.8
< 4 > KEROSENE= 107671                      < 5 > LGO= 48108.6
< 6 > HVGO= 123780                          < 7 > RESIDUUM= 30695.2
< 8 > FCCU FEED= 126770                     < 9 > REFORMER FEED= 62500
< 10 > CAT POLY FEED= 1E-06                 < 11 > ALKYLATION FEED= 29100
< 12 > LCO= 20283.2                         < 13 > HCO= 5070.8
< 14 > CRACKED GAS= 72322.3                 < 15 > POLYMER= 4.08466E-07
< 16 > LE FROM POLY (FOE)= 3.12969E-07      < 17 > REFORMATE= 51094.7
< 18 > LE FROM CAT CRACKER (FOE)= 18722.1   < 19 > FUEL GAS (FOE)= 28045.8
< 20 > I-C4 FR. GAS PLANT= 5954.16          < 21 > I-C4 IMPORTED= 3050.22
< 22 > LEADED REGULAR= 51175                < 23 > UNLEADED REGULAR= 104062
< 24 > UNLEADED PREMIUM= 15348              < 25 > AVIATION GASOLINE= 126
< 26 > REFORMATE= 28513.7                   < 27 > NAPETHA SPECIALTIES= 22581
< 28 > LSR= 40941.8                         < 29 > LSR+ISO= 40179.9
< 30 > LSR= 470.47                          < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 154475                < 33 > VAC RESID TO ASPHALT PLANT= 8366
< 34 > VAC RESIDUUM= 22329.2                < 35 > LCO= 5873
< 36 > HVGO TO LUBE OIL= 10882              < 37 > HVGO= 0
< 38 > LCO= 14410.2                         < 39 > C3/C4 -FCCU= 20095.6
< 40 > LGO= 18950.5                         < 41 > LGO= .99707
< 42 > JET FUEL B= 4277                     < 43 > JET FUEL A= 19625
< 44 > STOVE OIL= 2264                      < 45 > LIGHT FUEL OIL= 38243
< 46 > DIESEL FUEL= 81959                   < 47 > HEAVY FUEL OIL= 33274
< 48 > RESID TO COKING= 0                   < 49 > REF C4 TO BLENDING = 8888.02
< 50 > ALKYLATE= 20807.1                    < 51 > CRUDE LIGHT ENDS= 2.98522
< 52 > TOTAL PRODUCT= 422752                < 53 > C2 % IN CRUDE FEED= .08668
< 54 > C3 % IN CRUDE FEED= .69156           < 55 > I-C4 % IN CRUDE FEED= .36344
< 56 > N-C4 % IN CRUDE FEED= 1.84354        < 57 > LE FROM REFORMER (FOE)= 10294.4
< 58 > NAPHTHA= 4865.84                     < 59 > KEROSENE= 18565.7
< 60 > KEROSENE= 89105.3                    < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 20095.6              < 63 > LE FROM ALKYL (FOE)= 2449.61
< 64 > HVGO= 97612.9                        < 65 > LGO = 29157.1
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285    < 67 > VGO PETROCHEMICAL FEED= 15285
< 68 > IMPORTED C4= 0                       < 69 > LSR= 40471.3




                          LIGHT ENDS BALANCE
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                                        *** FROM ***
                CRUDE UNIT    REFORMER      CAT CRACKER   POLY           ALKYL         ISO          TOTAL
C2   ,#/HR      2032.73       7711.27       36296.1       0              0             0            46040.1
C3   ,#/HR      22885.5       21062.2       27495.7       0              14690.7       673.847      86808
IC4   ,#/HR     13376.2       13462.6       64692.5       0              0             1199.08      92730.4
NC4   ,#/HR     70257.6       19647.2       24342.5       0              15483.3       3414.4       133145
H2   ,#/HR      0             19757.9       14771.4       0              0             0            34529.3
C1   ,#/HR      0             7711.27       15049.6       0              0             0            22760.9
H2S   ,#/HR     0             0             4729.24       0              0             0            4729.24
C2=   ,#/HR     0             0             22131.8       0              0             0            22131.8
C3=   ,#/HR     0             0             65002.4       0              0             0            65002.4
C4=   ,#/HR     0             0             96529.9       0              0             0            96529.9
TOTAL   ,#/HR   108552        89352.4       371041        3.87753E-06    30174         5287.33      604407
BPCD (POE)      8777.68       10294.4       31803.7       3.12969E-07    2449.61       426.455      53751.8

                                        *** TO ***
                POLY          ALKY          GAS BLEND     PC FEED        DDS           FUEL GAS     TOTAL
C2   ,#/HR      0             0             0             0              0             46040.1      46040.1
C3   ,#/HR      0             14690.7       0             0              0             72117.3      86808
IC4   ,#/HR     0             90151.2       1263.24       0              0             1315.99      92730.4
NC4   ,#/HR     0             15483.3       57630.8       0              0             60030.9      133145
H2   ,#/HR      0             0             0             0              10960.5       23568.8      34529.3
C1   ,#/HR      0             0             0             0              0             22760.9      22760.9
H2S   ,#/HR     0             0             0             0              0             4729.24      4729.24
C2=   ,#/HR     0             0             0             0              0             22131.8      22131.8
C3=   ,#/HR     0             32249.5       0             0              0             32752.9      65002.4
C4=   ,#/HR     0             61399         17207.1       0              0             17923.9      96529.9
TOTAL   ,#/HR   8.2093E-06    213974        76101.1       0              10960.5       303372       604407
BPCD (POE)      6.54138E-07   17080.7       6095.69       0              2529.68       28045.8      53751.8
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                             **** OVERALL MASS BALANCE ****
*** FEED ***

                             BPCD                         #/HR

CRUDE                         447197                       5.47841E+06
BUTANE                        3050.22                      25103.3
TOTAL                         450247                       5.50351E+06


*** PRODUCT ***

FUEL GAS (FOE)                28045.8                      303372
MOTOR GASOLINE                170711                       1.79635E+06
AVIATION TURBO FUELS          23902                        283491
DISTILLATES                   122466                       1.52868E+06
HEAVY FUEL OIL                33274                        506121
OTHER PRODUCTS                72399                        912159
H2 TO DESULFURIZERS (FOE)     2529.68                      10960.5
COKE (FOE)                    8661.73                      162631
TOTAL                         461989                       5.50376E+06
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TIME:13.56.22 DATE:MONAPR301984121 40
         REFINERY SIMULATION PROGRAM
        CASE:ONTBAS10 REGION:ONTARIO
         **** FEED BLEND ****
          CRUDE ORIGIN            LV %          BPCD
           CANDWL                 49            220036
           CANDNH                 9.2           41312.8
           SYNCRUDE               30.8          138308
           CONDENSA               11            49395.7
            No.  MBP         LV %       S.G.       API        SULFUR WT%  BPCD       Lbs/hr FEED    Lbs/hr SULFUR
             Total           100                                          449052       5.50114E+06    26534.4
             Average                   .840979    36.7563      .482344

             **** MATERIAL BALANCE ****

                        CRUDE UNIT
            No. Name          BPCD       Lbs/hr       IBP       EBP       S.G.      API         SULFUR WT%  Lbs/hr Su
                        *** FEED ***
            0   CRUDE FEED    449052     5.50114E+06  60        1300      .840981   36.756       .482344     26534.4
                        *** PRODUCT ***
            2   OVERHEAD      54542.7    509612       60        170.136   .641406   89.1092      .028921     147.385
            28  LSR           41137.5    400585       60        170.136   .668478   80.1749      .0367951    147.396
            3   NAPHTHA       82650.8    906971       170.136   321.804   .753314   56.3367      .0268543    243.561
            4   KEROSENE      108435     1.31688E+06  321.804   560       .833696   38.2261      .106943     1408.31
            5   LGO           48308.1    621519       560       660       .88321    28.711       .312237     1940.61
            1   REDUCED CRUDE 155116     2.14616E+06  660       1300      .949805   17.478       1.06211     22794.5

                        VACUUM UNIT
            No. Name          BPCD       Lbs/hr       IBP       EBP       S.G.      API         SULFUR WT%  Lbs/hr Su
                        *** FEED ***
            32  REDUCED CRUDE 155116     2.14616E+06  660       1300      .949805   17.478       1.06211     22794.5
                        *** PRODUCT ***
            6   HVGO          124294     1.67138E+06  660       1050      .923111   21.786       .618341     10334.8
            7   RESIDUUM      30822.4    474789       1050      1300      1.05746   2.31122      2.62443     12460.5

                        CAT CRACKER
            No. Name          BPCD       Lbs/hr       IBP       EBP       S.G.      API         SULFUR WT%  Lbs/hr Su
                        *** FEED ***
            65  LGO           30648.4    394314       560       660       .88321    28.711       .312237     1231.19
            64  HVGO          98126.6    1.3195E+06   660       1050      .923111   21.786       .618341     8159.04
                        *** TOTAL FEED ***
            8   FCCU FEED     128775     1.71382E+06  560       1050      .913615   23.3792      .547913     9390.23
                        *** PRODUCT ***
            12  LCO           20604      289446       430       650       .964375   15.2272      .948254     2744.68
            13  HCO           5151       80834.1      650       736.422   1.07729   -.151901     1.49824     1211.09
            14  CRACKED GAS   73561      803044                           .749414   57.3142      .0538167    432.172
            39  C3/C4 -FCCU   20096.2    164966                           .563522   119.6        0           0
            *** PRODUCT ***
            < 18 > LE FROM CAT CRACKER (FOE)= 19203
            AVAILABLE C3/C4 OLEFINS= 32111.2
            CONVERSION Wt%= 78.3944     CONVERSION Vol %= 80
            COKE, WT% 9.5674
            COKE  ,#/HR 164052          Sulfur in Flue Gas,Lbs/hr= 502.061

                        CAT POLY UNIT
            *** FEED ***
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< 10 > CAT POLY FEED= 1E-06
*** PRODUCT ***
< 15 > POLYMER= 4.08517E-07
< 16 > LE FROM POLY (FOE)= 3.12884E-07

              ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 29101.3
< 62 > C3/C4 TO ALKYL= 20096.2
< 20 > I-C4 FR. GAS PLANT= 6349.09
< 21 > I-C4 IMPORTED= 2655.97
*** PRODUCT ***
< 50 > ALKYLATE= 20811.3
< 63 > LE FROM ALKYL (FOE)= 2446.24

              CATALYTIC REFORMER UNIT
No. Name             BPCD        Lbs/hr          IBP          EBP          S.G.        API            SULFUR WT%   Lbs/hr Su
              *** FEED ***
 9  REFORMER FEED 62500          685845          170.136      321.804      .753314     56.3367          0             0
              *** PRODUCT ***
17  REFORMATE        49998.2     587059                                    .806041     44.0493          0             0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 11472
CONVERSION(LV%)= 79.9971    Severity (RON Clear)= 98    FEED KW= 11.8534

              GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 54542.7
< 57 > LE FROM REFORMER (FOE)= 11472
< 18 > LE FROM CAT CRACKER (FOE)= 19203
< 16 > LE FROM POLY (FOE)= 3.12884E-07
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 30017.8
< 20 > I-C4 FR. GAS PLANT= 6349.09
< 49 > REF C4 TO BLENDING = 8905.13
< 69 > LSR= 40667

              ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 40667
*** PRODUCT ***
< 29 > LSR+ISO= 40016.4

*** BY-PASS= 0 %   ***

              GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 40016.4
< 26 > REFORMATE= 27417.2
< 50 > ALKYLATE= 20811.3
< 15 > POLYMER= 4.08517E-07
< 14 > CRACKED GAS= 73561
< 49 > REF C4 TO BLENDING = 8905.13
< 68 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 17058
< 23 > UNLEADED REGULAR= 138179
< 24 > UNLEADED PREMIUM= 15348
< 25 > AVIATION GASOLINE= 126

*** GASOLINE COMPOSITION ***

               LR           UR            UP          AV

LSR            .860006      .183432       0           0
CRACKED GAS    .129027      .494          .201956     0
REFORMATE      0            .129695       .618718     0
POLYMER        0            2.95644E-12   0           0
ALKYLATE       0            .1375         .11         .9786
C4             .0109674     .055373       .0693267    .0214

                  TURBO FUEL BLENDING
   *** FEED ***
   < 30 > LSR= 470.47
   < 58 > NAPHTHA= 4865.84
   < 59 > KEROSENE= 18565.7
   *** PRODUCT ***
   < 42 > JET FUEL B= 4277
   < 43 > JET FUEL A= 19625

   *** TURBO FUEL COMPOSITION ***

                 NAPHTHA BASE  KEROSENE BASE

   LSR           .11           0
   NAPHTHA       .61           .115
   KEROSENE      .28           .885

                  DISTILLATE BLENDING
   *** FEED ***
   < 60 > KEROSENE= 89868.9
   < 40 > LGO= 17659
   < 38 > LCO= 14938
   *** PRODUCT ***
   < 44 > STOVE OIL= 2264
   < 45 > LIGHT FUEL OIL= 38243
   < 46 > DIESEL FUEL= 81959

   *** DISTILLATE COMPOSITION ***

                 STOVE OIL     DIESEL FUEL    LFO

   KEROSENE      1             .7             .790567
   LCO           0             .1             .176296
   LGO           0             .2             .0331366

                  HEAVY FUEL OIL BLENDING
   *** FEED ***
   < 41 > LGO= .648438
   < 35 > LCO= 5666
   < 13 > HCO= 5151
   < 37 > HVGO= 0
   < 31 > REDUCED CRUDE= 0
   < 34 > VAC RESIDUUM= 22456.4
   *** PRODUCT ***
   < 47 > HEAVY FUEL OIL= 33274
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                 OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 22581
< 36 > HVGO TO LUBE OIL= 10882
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 8366
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285
< 67 > VGO PETROCHEMICAL FEED= 15285

                              DISTILLATE DESULFURIZATION

STREAM            TOTAL              FEED  TO  DDS                                         FINAL STREAM
                  BPCD         BPCD      Lbs/hr       SULFUR WT%          % BYPASS         SULFUR WT%
KEROSENE          108435       108435    1.31688E+06  .106943             0                5.35259E-03
LGO               17659.7      17659.7   227205       .312237             1.10598E-05      .0313117
LCO               20604        18543.6   260501       .948254             10               .181563
HCO               5151         0         0            1.49824             100              1.49824
VAC RESIDUUM      22456.4      0         0            2.62443             100              2.62443


  ***PRODUCT SLATES & SPECIFICATIONS***

               JET FUEL B   JET FUEL A    STOVE OIL     LFO          DIESEL FUEL   HFO

BPCD           4277         19625         2264          38243        81959         33274
S.G.           .766489      .824452       .833696       .858375      .856667       1.04467
ASTM 10%       206.68       345.264       384.856       392.281      396.166
ASTM 20%       224.011      368.75        399.72        413.449      421.119
ASTM 50%       273.608      432.797       448.254       470.853      489.775
ASTM 90%       468.319      516.981       519.59        545.86       599.315
RVP,psia       2.9364
Sulfur Wt %    .021258      7.60705E-03   5.34713E-03   .0408557     .0303629      2.06038
Flash Point,F  64.3686      133.934       144.638       148.55       150.645
Pour Point,F   -95.7017     -50.1482      -44.5865      -52.9935     -37.8347
Cetane No.                                                           41.5094
Visc @100F,cs  .773613      1.61855       1.82924       2.1032       2.37375       1961.98
Visc @122F,cs  .682447      1.37991       1.54879       1.76072      1.9762        677.461
Watsons K      11.8225      11.6396       11.5965       11.3404      11.4455       10.7709
MeABP          284.131      423.715       443.665       462.4        482.628       964.72

               GASOLINE

LEADED REGULAR,BPCD              17058
TEL Addition,cc/IG: 1.24
RON / MON / (R+M)/2 (Clear)      86.1166 / 82.7487 / 84.4327
RON / MON / (R+M)/2              91.6879 / 87.9536 / 89.8208
RVP,psia                         15.7255

MMT Addition,mg/l: 0
UNLEADED REGULAR,BPCD            138179
RON / MON / (R+M)/2              92.9311 / 85.2141 / 89.0726
RVP,psia                         11.1044

UNLEADED PREMIUM,BPCD            15348
RON / MON / (R+M)/2              96.3999 / 87.2319 / 91.8159
RVP,psia                         9.75758
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AVIATION GASOLINE,BPCD         126
RON / MON / (R+M)/2            93 / 90.8 / 91.9
RVP,psia                       10


                      STREAMS

< 0 > CRUDE FEED= 449052                         < 1 > REDUCED CRUDE= 155116
< 2 > OVERHEAD= 54542.7                          < 3 > NAPHTHA= 82650.8
< 4 > KEROSENE= 108435                           < 5 > LGO= 48308.1
< 6 > HVGO= 124294                               < 7 > RESIDUUM= 30822.4
< 8 > FCCU FEED= 128775                          < 9 > REFORMER FEED= 62500
< 10 > CAT POLY FEED= 1E-06                      < 11 > ALKYLATION FEED= 29101.3
< 12 > LCO= 20604                                < 13 > HCO= 5151
< 14 > CRACKED GAS= 73561                        < 15 > POLYMER= 4.08517E-07
< 16 > LE FROM POLY (FOE)= 3.12884E-07           < 17 > REFORMATE= 49998.2
< 18 > LE FROM CAT CRACKER (FOE)= 19203          < 19 > FUEL GAS (FOE)= 30017.8
< 20 > I-C4 FR. GAS PLANT= 6349.09               < 21 > I-C4 IMPORTED= 2655.97
< 22 > LEADED REGULAR= 17058                     < 23 > UNLEADED REGULAR= 138179
< 24 > UNLEADED PREMIUM= 15348                   < 25 > AVIATION GASOLINE= 126
< 26 > REFORMATE= 27417.2                        < 27 > NAPHTHA SPECIALTIES= 22581
< 28 > LSR= 41137.5                              < 29 > LSR+ISO= 40016.4
< 30 > LSR= 470.47                               < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 155116                     < 33 > VAC RESID TO ASPHALT PLANT= 8366
< 34 > VAC RESIDUUM= 22456.4                     < 35 > LCO= 5666
< 36 > HVGO TO LUBE OIL= 10882                   < 37 > HVGO= 0
< 38 > LCO= 14938                                < 39 > C3/C4 -FCCU= 20096.2
< 40 > LGO= 17659                                < 41 > LGO= .648438
< 42 > JET FUEL B= 4277                          < 43 > JET FUEL A= 19625
< 44 > STOVE OIL= 2264                           < 45 > LIGHT FUEL OIL= 38243
< 46 > DIESEL FUEL= 81959                        < 47 > HEAVY FUEL OIL= 33274
< 48 > RESID TO COKING= 0                        < 49 > REF C4 TO BLENDING = 8905.13
< 50 > ALKYLATE= 20811.3                         < 51 > CRUDE LIGHT ENDS= 2.98522
< 52 > TOTAL PRODUCT= 422752                     < 53 > C2 % IN CRUDE FEED= .08668
< 54 > C3 % IN CRUDE FEED= .69156                < 55 > I-C4 % IN CRUDE FEED= .36344
< 56 > N-C4 % IN CRUDE FEED= 1.84354             < 57 > LE FROM REFORMER (FOE)= 11472
< 58 > NAPHTHA= 4865.84                          < 59 > KEROSENE= 18565.7
< 60 > KEROSENE= 89868.9                         < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 20096.2                   < 63 > LE FROM ALKYL (FOE)= 2446.24
< 64 > HVGO= 98126.6                             < 65 > LGO = 30648.4
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285         < 67 > VGO PETROCHEMICAL FEED= 15285
< 68 > IMPORTED C4= 0                            < 69 > LSR= 40667
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LIGHT ENDS BA NCE

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                              *** FROM ***
              CRUDE UNIT   REFORMER   CAT CRACKER  POLY          ALKYL      ISO        TOTAL
C2   ,#/HR    2041.17      8853.66    36731.2      0             0          0          47626
C3   ,#/HR    22980.4      23547.1    27930.5      0             14683.1    1504.68    90645.8
IC4   ,#/HR   13431.7      14278.5    65787.3      0             0          2677.52    96175
NC4   ,#/HR   70549        20838      24685.9      0             15449.2    7624.26    139146
H2   ,#/HR    0            22415.2    14948.7      0             0          0          37363.9
C1   ,#/HR    0            8853.66    15230        0             0          0          24083.7
H2S   ,#/HR   0            0          4781.49      0             0          0          4781.49
C2=   ,#/HR   0            0          22397        0             0          0          22397
C3=   ,#/HR   0            0          66215.3      0             0          0          66215.3
C4=   ,#/HR   0            0          98012.3      0             0          0          98012.3
TOTAL   ,#/HR 109002       98786.1    376720       3.87649E-06   30132.3    11806.5    626447
BPCD (POE)    8814.09      11472      32283.5      3.12884E-07   2446.24    952.263    55968.1

                              *** TO ***
              POLY         ALKY       GAS BLEND    PC FEED       DDS        FUEL GAS   TOTAL
C2   ,#/HR    0            0          0            0             0          47626      47626
C3   ,#/HR    0            14683      0            0             0          75962.8    90645.8
IC4   ,#/HR   0            93424.8    1285.46      0             0          1464.78    96175
NC4   ,#/HR   0            15449.2    57817.7      0             0          65879.5    139146
H2   ,#/HR    0            0          0            0             10838.7    26525.2    37363.9
C1   ,#/HR    0            0          0            0             0          24083.7    24083.7
H2S   ,#/HR   0            0          0            0             0          4781.49    4781.49
C2=   ,#/HR   0            0          0            0             0          22397      22397
C3=   ,#/HR   0            32322.9    0            0             0          33892.4    66215.3
C4=   ,#/HR   0            61339.2    17141.5      0             0          19531.6    98012.3
TOTAL   ,#/HR 8.20882E-06  217219     76244.7      0             10838.7    322144     626447
BPCD (POE)    6.541E-07    17341.4    6107.37      0             2501.57    30017.8    55968.1
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                                **** OVERALL MASS BALANCE ****
*** FEED ***

                                BFCD                    #/HR

CRUDE                           449052                  5.50114E+06
BUTANE                          2655.97                 21858.6
TOTAL                           451708                  5.523E+06


*** PRODUCT ***

FUEL GAS (FOE)                  30017.8                 322144
MOTOR GASOLINE                  170711                  1.79435E+06
AVIATION TURBO FUELS            23902                   283447
DISTILLATES                     122466                  1.52846E+06
HEAVY FUEL OIL                  33274                   506354
OTHER PRODUCTS                  72399                   913604
H2 TO DESULFURIZERS (FOE)       2501.57                 10838.7
COKE (FOE)                      8737.41                 164052
TOTAL                           464009                  5.52325E+06
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TIME:10.09.41 DATE:MONAPR301984121 40
        REFINERY SIMULATION PROGRAM
        CASE:WESBAS11 REGION:WESTERN
         **** FEED BLEND ****
          CRUDE ORIGIN              LV %          BPCD
           CANDML                   65.1          321986
           SYNCRUDE                 31.5          155800
           CONDENSA                 3.4           16816.5
            No.  MBP          LV %        S.G.         API          SULFUR WT%  BPCD          Lbs/hr FEED       Lbs/hr SULFUR
             Total            100                                               494602           6.08195E+06     18927.1
             Average                      .844146      36.1252      .311201

              **** MATERIAL BALANCE ****

                            CRUDE UNIT
            No. Name            BPCD          Lbs/hr        IBP          EBP          S.G.        API           SULFUR WT%   Lbs/hr Su
                            *** FEED ***
            0   CRUDE FEED      494602        6.08195E+06   60           1240         .844145     36.1253        .311201      18927.1
                            *** PRODUCT ***
            2   OVERHEAD        49203         456098        60           170.075      .636351     90.8617        .0147284     67.1758
            28  LSR             33729.7       331296        60           170.075      .67427      78.3566        .0202685     67.1488
            3   NAPHTHA         86951.1       958394        170.075      323.136      .756657     55.5068        .0149104     142.9
            4   KEROSENE        127459        1.54714E+06   323.136      560          .833278     38.3113        .0626007     968.522
            5   LGO             56420.2       724056        560          660          .880983     29.116         .219173      1586.94
            1   REDUCED CRUDE   174568        2.39626E+06   660          1240         .942321     18.6611        .67445       16161.6

                            VACUUM UNIT
            No. Name            BPCD          Lbs/hr        IBP          EBP          S.G.        API           SULFUR WT%   Lbs/hr Su
                            *** FEED ***
            32  REDUCED CRUDE   174568        2.39626E+06   660          1240         .942321     18.6611        .67445       16161.6
                            *** PRODUCT ***
            6   HVGO            142918        1.91392E+06   660          1050         .919318     22.4184        .412657      7897.91
            7   RESIDUUM        31650.1       482352        1050         1240         1.04621     3.75011        1.7133       8264.14

                            CAT CRACKER
            No. Name            BPCD          Lbs/hr        IBP          EBP          S.G.        API           SULFUR WT%   Lbs/hr Su
                            *** FEED ***
            65  LGO             5726.92       73495.2       560          660          .880983     29.116         .219173      161.082
            64  HVGO            137446        1.84064E+06   660          1050         .919318     22.4184        .412657      7595.51
                            *** TOTAL FEED ***
            8   FCCU FEED       143173        1.91413E+06   560          1050         .917784     22.6757        .405228      7756.6
                            *** PRODUCT ***
            12  LCO             22907.7       324293        430          650          .97182      14.1031        .699967      2269.94
            13  HCO             5726.92       90207.3       650          736.619      1.08131     -.640213       1.10595      997.647
            14  CRACKED GAS     80517.6       880405                                  .750622     57.0103        .040548      356.986
            39  C3/C4 -FCCU     35429         291071                                  .563988     119.392        0            0
            *** PRODUCT ***
            < 18 > LE FROM CAT CRACKER (FOE)= 13277.3
            AVAILABLE C3/C4 OLEFINS= 35429.1
            CONVERSION Wt%= 78.3453     CONVERSION Vol %= 80
            COKE, WT% 10.3436
            COKE  ,#/HR 198091          Sulfur in Flue Gas,Lbs/hr= 414.702

                            CAT POLY UNIT
            *** FEED ***
            < 10 > CAT POLY FEED= 15000
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*** PRODUCT ***
< 15 > POLYMER= 6115.81
< 16 > LE FROM POLY (FOE)= 4711.87

                ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 29571
< 62 > C3/C4 TO ALKYL= 20429
< 20 > I-C4 FR. GAS PLANT= 7529.12
< 21 > I-C4 IMPORTED= 1612.87
*** PRODUCT ***
< 50 > ALKYLATE= 21101.8
< 63 > LE FROM ALKYL (FOE)= 2533.77

                CATALYTIC REFORMER UNIT
No. Name              BPCD         Lbs/hr          IBP          EBP         S.G.        API          SULFUR WT%  Lbs/hr Su
                *** FEED ***
 9  REFORMER FEED 72200         795804         170.075      323.136     .756657    55.5068         0             0
                  *** PRODUCT ***
 17 REFORMATE      59424.8      695850                                  .803856    44.5267         0             0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 11491
CONVERSION(LV%)= 82.3058    Severity (RON Clear)= 96.5  FEED KW= 11.814

                GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 49203
< 57 > LE FROM REFORMER (FOE)= 11491
< 18 > LE FROM CAT CRACKER (FOE)= 13277.3
< 16 > LE FROM POLY (FOE)= 4711.87
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 25185.2
< 20 > I-C4 FR. GAS PLANT= 7529.12
< 49 > REF C4 TO BLENDING = 12037
< 69 > LSR= 31014.9

                ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 31014.9
*** PRODUCT ***
< 29 > LSR+ISO= 31014.9

*** BY-PASS= 100 %   ***

                GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 31014.9
< 26 > REFORMATE= 52442.8
< 50 > ALKYLATE= 21101.8
< 15 > POLYMER= 6115.81
< 14 > CRACKED GAS= 80517.6
< 49 > REF C4 TO BLENDING = 12037
< 68 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 60195
< 23 > UNLEADED REGULAR= 126555
< 24 > UNLEADED PREMIUM= 13901
< 25 > AVIATION GASOLINE= 2579
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     *** GASOLINE COMPOSITION ***

                LR            UR            UP            AV

LSR            .256619       .123281       0             0
CRACKED GAS    .580743       .36           0             0
REFORMATE      .104836       .28442        .729259       0
POLYMER        0             .0483253      0             0
ALKYLATE       0             .123722       .21           .9786
C4             .0578024      .0602511      .0607415      .0214

                TURBO FUEL BLENDING
     *** FEED ***
     < 30 > LSR= 2714.79
     < 58 > NAPHTHA= 14374
     < 59 > KEROSENE= 20903.2
     *** PRODUCT ***
     < 42 > JET FUEL B= 20883
     < 43 > JET FUEL A= 17109

     *** TURBO FUEL COMPOSITION ***

                NAPHTHA BASE  KEROSENE BASE

     LSR         .13           0
     NAPHTHA     .59           .12
     KEROSENE    .28           .88

                DISTILLATE BLENDING
     *** FEED ***
     < 60 > KEROSENE= 106556
     < 40 > LGO= 50692.3
     < 38 > LCO= 19878.7
     *** PRODUCT ***
     < 44 > STOVE OIL= 5913
     < 45 > LIGHT FUEL OIL= 13398
     < 46 > DIESEL FUEL= 157816

     *** DISTILLATE COMPOSITION ***

                STOVE OIL     DIESEL FUEL   LFO

     KEROSENE    1             .63           .0909767
     LCO         0             .1            .305798
     LGO         0             .27           .603226

                HEAVY FUEL OIL BLENDING
     *** FEED ***
     < 41 > LGO= .955078
     < 35 > LCO= 3029
     < 13 > HCO= 5726.92
     < 37 > HVGO= 0
     < 31 > REDUCED CRUDE= 0
     < 34 > VAC RESIDUUM= 15585.1
     *** PRODUCT ***
     < 47 > HEAVY FUEL OIL= 24342
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                OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 6982
< 36 > HVGO TO LUBE OIL= 5472
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 16065
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 377
< 67 > VGO PETROCHEMICAL FEED= 0

                          DISTILLATE DESULFURIZATION

STREAM               TOTAL               FEED   TO   DDS                                      FINAL STREAM
                     BPCD         BPCD        Lbs/hr       SULFUR WT%             % BYPASS       SULFUR WT%
KEROSENE             127459        127459       1.54714E+06  .0626007              0               3.1319E-03
LGO                  50693.3       50693.3     650561         .219173             -3.85283E-05   .0219605
LCO                  22907.7       11453.8     162146         .699967              50.0002        .3862
HCO                  5726.92       0           0             1.10595               100            1.10595
VAC RESIDUUM         15585.1       0           0             1.7133                100            1.7133


   ***PRODUCT SLATES & SPECIFICATIONS***

                JET FUEL B    JET FUEL A     STOVE OIL     LFO           DIESEL FUEL    HPO

BPCD             20883          17109          5913          13398          157816        24342
S.G.             .7674          .824083        .833278       .904421        .860013       1.0452
ASTM 10%         198.144        341.696        387.407       493.294        402.047
ASTM 20%         219.367        367.489        401.652       533.262        429.203
ASTM 50%         274.628        432.377        448.46        587.986        504.403
ASTM 90%         468.637        517.008        519.723       624.902        607.364
RVP,psia         2.56684
Sulfur Wt %      .0119408       4.42802E-03    3.13004E-03   .139641        .0514758      1.41173
Flash Point,F    59.5734        131.963        146.009       205.191        153.852
Pour Point,F    -98.0589       -50.4064       -43.5552      -18.7481       -32.9398
Cetane No.                                                                  42.4918
Visc @100F,cs    .766605        1.61034        1.83916       4.69241        2.56327       1425.29
Visc @122F,cs    .676423        1.37329        1.55694       3.7103         2.1242        517.996
Watsons K        11.7974        11.6411        11.6067       11.1701        11.4473       10.73
MeABP            282.032        422.866        444.691       571.07         494.182       950.67

                GASOLINE

LEADED REGULAR,BPCD                60195
TEL Addition,cc/IG: 1.24
RON / MON / (R+M)/2 (Clear)   89.6654 / 81.0294 / 85.3474
RON / MON / (R+M)/2           94.4682 / 85.2468 / 89.8575
RVP,psia                      10.4108

MMT Addition,mg/l: 18
UNLEADED REGULAR,BPCD         126555
RON / MON / (R+M)/2           93.43 / 84.5971 / 89.0136
RVP,psia                      10.0791

UNLEADED PREMIUM,BPCD         13901
RON / MON / (R+M)/2           95.8859 / 87.7336 / 91.8098
RVP,psia                      9.73116
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AVIATION GASOLINE,BPCD        2579
RON / MON / (R+M)/2           93 / 90.8 / 91.9
RVP,psia                      10



                        STREAMS

< 0 > CRUDE FEED= 494602                      < 1 > REDUCED CRUDE= 174568
< 2 > OVERHEAD= 49203                         < 3 > NAPHTHA= 86951.1
< 4 > KEROSENE= 127459                        < 5 > LGO= 56420.2
< 6 > HVGO= 142918                            < 7 > RESIDUUM= 31650.1
< 8 > FCCU FEED= 143173                       < 9 > REFORMER FEED= 72200
< 10 > CAT POLY FEED= 15000                   < 11 > ALKYLATION FEED= 29571
< 12 > LCO= 22907.7                           < 13 > HCO= 5726.92
< 14 > CRACKED GAS= 80517.6                   < 15 > POLYMER= 6115.81
< 16 > LE FROM POLY (FOE)= 4711.87            < 17 > REFORMATE= 59424.8
< 18 > LE FROM CAT CRACKER (FOE)= 13277.3     < 19 > FUEL GAS (FOE)= 25185.2
< 20 > I-C4 FR. GAS PLANT= 7529.12            < 21 > I-C4 IMPORTED= 1612.87
< 22 > LEADED REGULAR= 60195                  < 23 > UNLEADED REGULAR= 126555
< 24 > UNLEADED PREMIUM= 13901                < 25 > AVIATION GASOLINE= 2579
< 26 > REFORMATE= 52442.8                     < 27 > NAPHTHA SPECIALTIES= 6982
< 28 > LSR= 33729.7                           < 29 > LSR+ISO= 31014.9
< 30 > LSR= 2714.79                           < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 174568                  < 33 > VAC RESID TO ASPHALT PLANT= 16065
< 34 > VAC RESIDUUM= 15585.1                  < 35 > LCO= 3029
< 36 > HVGO TO LUBE OIL= 5472                 < 37 > HVGO= 0
< 38 > LCO= 19878.7                           < 39 > C3/C4 -FCCU= 35429
< 40 > LGO= 50692.3                           < 41 > LGO= .955078
< 42 > JET FUEL B= 20883                      < 43 > JET FUEL A= 17109
< 44 > STOVE OIL= 5913                        < 45 > LIGHT FUEL OIL= 13398
< 46 > DIESEL FUEL= 157816                    < 47 > HEAVY FUEL OIL= 24342
< 48 > RESID TO COKING= 0                     < 49 > REF C4 TO BLENDING = 12037
< 50 > ALKYLATE= 21101.8                      < 51 > CRUDE LIGHT ENDS= 3.12845
< 52 > TOTAL PRODUCT= 471587                  < 53 > C2 % IN CRUDE FEED= .10416
< 54 > C3 % IN CRUDE FEED= .87234             < 55 > I-C4 % IN CRUDE FEED= .41795
< 56 > N-C4 % IN CRUDE FEED= 1.734            < 57 > LE FROM REFORMER (FOE)= 11491
< 58 > NAPHTHA= 14374                         < 59 > KEROSENE= 20903.2
< 60 > KEROSENE= 106556                       < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 20429                  < 63 > LE FROM ALKYL (FOE)= 2533.77
< 64 > HVGO= 137446                           < 65 > LGO = 5726.92
< 66 > NAPHTHA PETROCHEMICAL FEED= 377        < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                         < 69 > LSR= 31014.9



                         LIGHT ENDS BALANCE

                           *** FROM ***
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                CRUDE UNIT   REFORMER    CAT CRACKER  POLY        ALKYL       ISO         TOTAL
C2   ,#/HR      2701.59      8526.86     43509.9      0           0           0           54738.4
C3   ,#/HR      31928.1      23522.7     31053.4      13508.5     15041       0           115054
IC4   ,#/HR     17013        15219.7     72106.5      32993.2     0           0           137332
NC4   ,#/HR     73088        22211.5     28046.9      11874.5     16172.3     0           151393
H2   ,#/HR      0            21946.5     17808.3      0           0           0           39754.8
C1   ,#/HR      0            8526.86     18040.7      0           0           0           26567.6
H2S   ,#/HR     0            0           3949.65      0           0           0           3949.65
C2=   ,#/HR     0            0           26530.4      0           0           0           26530.4
C3=   ,#/HR     0            0           70798        0           0           0           70798
C4=   ,#/HR     0            0           109611       0           0           0           109611
TOTAL   ,#/HR   124731       99954.1     421455       58376.2     31213.3     0           735729
BPCD (FOE)      10094.4      11491       36417.1      4711.86     2533.77     0           65248.1

                        *** TO ***
                POLY         ALKY        GAS BLEND    PC FEED     DDS         FUEL GAS    TOTAL
C2   ,#/HR      0            0           0            0           0           54738.4     54738.4
C3   ,#/HR      11043.8      15040.9     0            0           0           88969       115054
IC4   ,#/HR     30528.5      103542      2639.95      0           0           621.495     137332
NC4   ,#/HR     11874.5      16172.3     99846.1      0           0           23500.3     151393
H2   ,#/HR      0            0           0            0           15771.5     23983.3     39754.8
C1   ,#/HR      0            0           0            0           0           26567.6     26567.6
H2S   ,#/HR     0            0           0            0           0           3949.65     3949.65
C2=   ,#/HR     0            0           0            0           0           26530.4     26530.4
C3=   ,#/HR     23380.1      31842.2     0            0           0           15575.7     70798
C4=   ,#/HR     46407.2      63203.5     0            0           0           0           109611
TOTAL   ,#/HR   123234       229801      102486       0           15771.5     264436      735729
BPCD (FOE)      9819.42      18349.8     8253.63      0           3640.05     25185.2     65248.1
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                         **** OVERALL MASS BALANCE ****
*** FEED ***

                          BPCD                     #/HR

CRUDE                     494602                   6.08195E+06
BUTANE                    1612.87                  13273.9
TOTAL                     496215                   6.09522E+06


*** PRODUCT ***

FUEL GAS (FOE)            25185.2                  264436
MOTOR GASOLINE            203230                   2.17834E+06
AVIATION TURBO FUELS      37992                    438829
DISTILLATES               177127                   2.22538E+06
HEAVY FUEL OIL            24342                    370617
OTHER PRODUCTS            28896                    404025
H2 TO DESULFURIZERS (FOE) 3640.05                  15771.5
COKE (FOE)                10550.3                  198091
TOTAL                     510963                   6.09548E+06
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TIME:11.16.16 DATE:MONAPR301984121 40
        REFINERY SIMULATION PROGRAM
        CASE:WESBAS10 REGION:WESTERN
         **** FEED BLEND ****
          CRUDE ORIGIN            LV %          BPCD
           CANDNL                 65.1          322250
           SYNCRUDE               31.5          155928
           CONDENSA               3.4           16830.3
           No.  MBP          LV %      S.G.       API         SULFUR WT%  BPCD      Lbs/hr FEED       Lbs/hr SULFUR
            Total            100                                          495008      6.08695E+06      18942.6
            Average                    .844145    36.1252     .311201

             **** MATERIAL BALANCE ****

                    CRUDE UNIT
           No. Name       BPCD       Lbs/hr       IBP       EBP       S.G.      API         SULFUR WT%  Lbs/hr Su
                    *** FEED ***
           0  CRUDE FEED  495008     6.08695E+06  60        1240      .844146   36.1251     .3112        18942.6
                    *** PRODUCT ***
           2  OVERHEAD    49059      454529       60        169.7     .636022   90.9765     .0147045     66.8359
           28 LSR         33572.9    329633       60        169.7     .674018   78.4351     .0203        66.9155
           3  NAPHTHA     86951.1    958175       169.7     322.689   .756484   55.5496     .0148985     142.754
           4  KEROSENE    127820     1.55136E+06  322.689   560       .833189   38.3294     .0625177     969.874
           5  LGO         56466.6    724652       560       660       .880983   29.116      .219173      1588.24
           1  REDUCED CRUDE 174712   2.39823E+06  660       1240      .942321   18.6611     .67445       16174.9

                    VACUUM UNIT
           No. Name       BPCD       Lbs/hr       IBP       EBP       S.G.      API         SULFUR WT%  Lbs/hr Su
                    *** FEED ***
           32 REDUCED CRUDE 174712   2.39823E+06  660       1240      .942321   18.6611     .67445       16174.9
                    *** PRODUCT ***
           6  HVGO        143041     1.91556E+06  660       1050      .919318   22.4184     .412657      7904.7
           7  RESIDUUM    31670.8    482667       1050      1240      1.04621   3.75011     1.7133       8269.54

                    CAT CRACKER
           No. Name       BPCD       Lbs/hr       IBP       EBP       S.G.      API         SULFUR WT%  Lbs/hr Su
                    *** FEED ***
           65 LGO         6031.2     77400.1      560       660       .880983   29.116      .219173      169.64
           64 HVGO        137569     1.84228E+06  660       1050      .919318   22.4184     .412657      7602.31
                    *** TOTAL FEED ***
           8  FCCU FEED   143600     1.91968E+06  560       1050      .917707   22.6886     .404857      7771.95
                    *** PRODUCT ***
           12 LCO         22976      325214       430       650       .971684   14.1235     .699348      2274.38
           13 HCO         5744       90469.6      650       736.615   1.08123   -.630524    1.10497      999.662
           14 CRACKED GAS 80778.8    883235                           .7506     57.0159     .040498      357.692
           39 C3/C4 -FCCU 35540      291979                           .563981   119.395     0            0
           *** PRODUCT ***
           < 18 > LE FROM CAT CRACKER (FOE)= 13307.7
           AVAILABLE C3/C4 OLEFINS= 35540
           CONVERSION Wt%= 78.3462     CONVERSION Vol %= 80
           COKE, WT% 10.3305
           COKE  ,#/HR 198414          Sulfur in Flue Gas,Lbs/hr= 415.55

                     CAT POLY UNIT
           *** FEED ***
           < 10 > CAT POLY FEED= 15000
```

```
*** PRODUCT ***
< 15 > POLYMER= 6116.06
< 16 > LE FROM POLY (FOE)= 4711.49

              ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 29732.1
< 62 > C3/C4 TO ALKYL= 20540
< 20 > I-C4 FR. GAS PLANT= 7744.22
< 21 > I-C4 IMPORTED= 1447.81
*** PRODUCT ***
< 50 > ALKYLATE= 21217.6
< 63 > LE FROM ALKYL (FOE)= 2546.65

              CATALYTIC REFORMER UNIT
 No. Name           BPCD        Lbs/hr        IBP         EBP          S.G.        API          SULFUR WT%  Lbs/hr Su
              *** FEED ***
 9   REFORMER FEED 72200        795622        169.7       322.689      .756484    55.5496         0           0
              *** PRODUCT ***
 17  REFORMATE     59418.6      695628                                 .803682    44.5646         0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 11495.8
CONVERSION(LV%)= 82.2972    Severity (RON Clear)= 96.5  FEED KW= 11.8146

              GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 49059
< 57 > LE FROM REFORMER (FOE)= 11495.8
< 18 > LE FROM CAT CRACKER (FOE)= 13307.7
< 16 > LE FROM POLY (FOE)= 4711.49
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 25741.2
< 20 > I-C4 FR. GAS PLANT= 7744.22
< 49 > REF C4 TO BLENDING = 12061.3
< 69 > LSR= 31067

              ISOMERIZATION UNIT
*** FEED ***
< 69 > LSR= 31067
*** PRODUCT ***
< 29 > LSR+ISO= 30619.6

*** BY-PASS= 10 %   ***

              GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 30619.6
< 26 > REFORMATE= 52436.6
< 50 > ALKYLATE= 21217.6
< 15 > POLYMER= 6116.06
< 14 > CRACKED GAS= 80778.8
< 49 > REF C4 TO BLENDING = 12061.3
< 68 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 20065
< 23 > UNLEADED REGULAR= 166685
< 24 > UNLEADED PREMIUM= 13901
< 25 > AVIATION GASOLINE= 2579
```

```
      *** GASOLINE COMPOSITION ***

                LR            UR            UP            AV

LSR          .611335       .11048        0             0
CRACKED GAS  .287593       .45           0             0
REFORMATE    .070918       .25217        .646047       0
POLYMER      0             .0366923      0             0
ALKYLATE     0             .0871247      .3            .9786
C4           .0301543      .0635331      .0539527      .0214

                    TURBO FUEL BLENDING
      *** FEED ***
      < 30 > LSR= 2505.96
      < 58 > NAPHTHA= 14374
      < 59 > KEROSENE= 21112
      *** PRODUCT ***
      < 42 > JET FUEL B= 20883
      < 43 > JET FUEL A= 17109

      *** TURBO FUEL COMPOSITION ***

                    NAPHTHA BASE  KEROSENE BASE

      LSR             .12           0
      NAPHTHA         .59           .12
      KEROSENE        .29           .88

                    DISTILLATE BLENDING
      *** FEED ***
      < 60 > KEROSENE= 106708
      < 40 > LGO= 50435.2
      < 38 > LCO= 19984
      *** PRODUCT ***
      < 44 > STOVE OIL= 5913
      < 45 > LIGHT FUEL OIL= 13398
      < 46 > DIESEL FUEL= 157816

      *** DISTILLATE COMPOSITION ***

                    STOVE OIL     DIESEL FUEL   LFO

      KEROSENE        1             .63           .102309
      LCO             0             .1            .313659
      LGO             0             .27           .584033

                    HEAVY FUEL OIL BLENDING
      *** FEED ***
      < 41 > LGO= .171875
      < 35 > LCO= 2992
      < 13 > HCO= 5744
      < 37 > HVGO= 0
      < 31 > REDUCED CRUDE= 0
      < 34 > VAC RESIDUUM= 15605.8
      *** PRODUCT ***
      < 47 > HEAVY FUEL OIL= 24342
```

```
              OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 6982
< 36 > HVGO TO LUBE OIL= 5472
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 16065
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 377
< 67 > VGO PETROCHEMICAL FEED= 0

                         DISTILLATE DESULFURIZATION

STREAM             TOTAL               FEED  TO  DDS                                         FINAL STREAM
                   BPCD        BPCD        Lbs/hr        SULFUR WT%           % BYPASS       SULFUR WT%
KEROSENE           127820      127820      1.55136E+06  .0625177              0              3.12774E-03
LGO                50435.4     50435.4     647252        .219173              7.74506E-06   .0219606
LCO                22976       11488       162607        .699348              50             .385856
HCO                5744        0           0             1.10497              100            1.10497
VAC RESIDUUM       15605.8     0           0             1.7133               100            1.7133


   ***PRODUCT SLATES & SPECIFICATIONS***

               JET FUEL B   JET FUEL A    STOVE OIL     LFO          DIESEL FUEL   HFO

BPCD            20883        17109         5913          13398         157816       24342
S.G.            .768832      .823985       .833189       .904543       .859943      1.04531
ASTM 10%        203.517      341.298       386.993       488.95        401.623
ASTM 20%        223.182      367.1         401.28        530.189       428.876
ASTM 50%        276.719      432.11        448.218       586.527       504.306
ASTM 90%        471.285      516.967       519.679       624.393       607.37
RVP,psia        2.93949
Sulfur Wt %     .0117669     4.42286E-03   3.12588E-03   .142363       .0514327     1.413
Flash Point,F  62.571        131.74        145.788       202.782       153.623
Pour Point,F  -97.0854      -50.5051      -43.6504      -20.1955      -32.999
Cetane No.                                                             42.5035
Visc @100F,cs  .77824         1.60777       1.83629       4.62382       2.56018      1448.49
Visc @122F,cs  .686281        1.37121       1.55464       3.65926       2.1218       524.922
Watsons K      11.7922        11.6413       11.6069       11.1613       11.4476      10.7305
MeABP          285.22         422.594       444.436       569.04        494.006      951.31

               GASOLINE

LEADED REGULAR,BPCD            20065
TEL Addition,cc/IG: 1.02
RON / MON / (R+M)/2 (Clear)   87.6558 / 82.6899 / 85.1729
RON / MON / (R+M)/2           92.4291 / 87.1973 / 89.8132
RVP,psia                       13.332

MMT Addition,mg/l: 0
UNLEADED REGULAR,BPCD          166685
RON / MON / (R+M)/2            93.15 / 84.9156 / 89.0328
RVP,psia                       10.438

UNLEADED PREMIUM,BPCD          13901
RON / MON / (R+M)/2            95.5493 / 88.1018 / 91.8256
RVP,psia                       9.74078
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AVIATION GASOLINE,BPCD        2579
RON / MON / (R+M)/2           93 / 90.8 / 91.9
RVP,psia                      10


                  STREAMS

< 0 > CRUDE FEED= 495008                       < 1 > REDUCED CRUDE= 174712
< 2 > OVERHEAD= 49059                          < 3 > NAPHTHA= 86951.1
< 4 > KEROSENE= 127820                         < 5 > LGO= 56466.6
< 6 > HVGO= 143041                             < 7 > RESIDUUM= 31670.8
< 8 > FCCU FEED= 143600                        < 9 > REFORMER FEED= 72200
< 10 > CAT POLY FEED= 15000                    < 11 > ALKYLATION FEED= 29732.1
< 12 > LCO= 22976                              < 13 > HCO= 5744
< 14 > CRACKED GAS= 80778.8                    < 15 > POLYMER= 6116.06
< 16 > LE FROM POLY (FOE)= 4711.49             < 17 > REFORMATE= 59418.6
< 18 > LE FROM CAT CRACKER (FOE)= 13307.7      < 19 > FUEL GAS (FOE)= 25741.2
< 20 > I-C4 FR. GAS PLANT= 7744.22             < 21 > I-C4 IMPORTED= 1447.81
< 22 > LEADED REGULAR= 20065                   < 23 > UNLEADED REGULAR= 166685
< 24 > UNLEADED PREMIUM= 13901                 < 25 > AVIATION GASOLINE= 2579
< 26 > REFORMATE= 52436.6                      < 27 > NAPHTHA SPECIALTIES= 6982
< 28 > LSR= 33572.9                            < 29 > LSR+ISO= 30619.6
< 30 > LSR= 2505.96                            < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 174712                   < 33 > VAC RESID TO ASPHALT PLANT= 16065
< 34 > VAC RESIDUUM= 15605.8                   < 35 > LCO= 2992
< 36 > HVGO TO LUBE OIL= 5472                  < 37 > HVGO= 0
< 38 > LCO= 19984                              < 39 > C3/C4 -FCCU= 35540
< 40 > LGO= 50435.2                            < 41 > LGO= .171875
< 42 > JET FUEL B= 20883                       < 43 > JET FUEL A= 17109
< 44 > STOVE OIL= 5913                         < 45 > LIGHT FUEL OIL= 13398
< 46 > DIESEL FUEL= 157816                     < 47 > HEAVY FUEL OIL= 24342
< 48 > RESID TO COKING= 0                      < 49 > REF C4 TO BLENDING = 12061.3
< 50 > ALKYLATE= 21217.6                       < 51 > CRUDE LIGHT ENDS= 3.12845
< 52 > TOTAL PRODUCT= 471587                   < 53 > C2 % IN CRUDE FEED= .10416
< 54 > C3 % IN CRUDE FEED= .87234              < 55 > I-C4 % IN CRUDE FEED= .41795
< 56 > N-C4 % IN CRUDE FEED= 1.734             < 57 > LE FROM REFORMER (FOE)= 11495.8
< 58 > NAPHTHA= 14374                          < 59 > KEROSENE= 21112
< 60 > KEROSENE= 106708                        < 61 > OLEFIN PETROCHEMICAL FEED=
< 62 > C3/C4 TO ALKYL= 20540                   < 63 > LE FROM ALKYL (FOE)= 2546.65
< 64 > HVGO= 137569                            < 65 > LGO = 6031.2
< 66 > NAPHTHA PETROCHEMICAL FEED= 377         < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                          < 69 > LSR= 31067



                     LIGHT ENDS BALANCE

                       *** FROM ***
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                CRUDE UNIT    REFORMER     CAT CRACKER   POLY         ALKYL        ISO          TOTAL
C2   ,#/HR       2703.81       8531.36     43601.6       0            0            0            54836.8
C3   ,#/HR      31954.3       23531.4      31146         13506.8      15120.4      1034.53      116293
IC4  ,#/HR      17026.9       15224.9      72340.6       32996.7      0            1840.9       139430
NC4  ,#/HR      73148.1       22219.2      28119.5       11868.1      16251.4      5241.99      156848
H2   ,#/HR      0             21956.5      17845.9       0            0            0            39802.4
C1   ,#/HR      0              8531.36     18078.7       0            0            0            26610.1
H2S  ,#/HR      0             0             3957.46      0            0            0            3957.46
C2=  ,#/HR      0             0            26586.4       0            0            0            26586.4
C3=  ,#/HR      0             0            71063.7       0            0            0            71063.7
C4=  ,#/HR      0             0            109927        0            0            0            109927
TOTAL  ,#/HR    124833        99994.7      422667        58371.6      31371.8      8117.42      745356
BPCD (FOE)      10102.7       11495.8      36519.7       4711.49      2546.64      654.719      66031.1

                             *** TO ***
                POLY          ALKY         GAS BLEND     PC FEED      DDS          FUEL GAS     TOTAL
C2   ,#/HR      0             0            0             0            0            54836.8      54836.8
C3   ,#/HR      11042.2       15120.4      0             0            0            90130.8      116293
IC4  ,#/HR      30532.1       105543       2608.07       0            0            746.391      139430
NC4  ,#/HR      11868.1       16251.4      100086        0            0            28642.8      156848
H2   ,#/HR      0             0            0             0            15752.7      24049.7      39802.4
C1   ,#/HR      0             0            0             0            0            26610.1      26610.1
H2S  ,#/HR      0             0            0             0            0            3957.46      3957.46
C2=  ,#/HR      0             0            0             0            0            26586.4      26586.4
C3=  ,#/HR      23394.6       32035.1      0             0            0            15634        71063.7
C4=  ,#/HR      46395.8       63531.3      0             0            0            0            109927
TOTAL  ,#/HR    123233        232482       102694        0            15752.7      271194       745356
BPCD (FOE)      9819.31       18564.5      8270.38       0            3635.73      25741.2      66031.1
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                         **** OVERALL MASS BALANCE ****
*** FEED ***

                         BPCD                     #/HR

CRUDE                     495008                   6.08695E+06
BUTANE                    1447.81                  11915.5
TOTAL                     496456                   6.09887E+06


*** PRODUCT ***

FUEL GAS (FOE)            25741.2                  271194
MOTOR GASOLINE            203230                   2.17461E+06
AVIATION TURBO FUELS      37992                    439240
DISTILLATES               177127                   2.22523E+06
HEAVY FUEL OIL            24342                    370656
OTHER PRODUCTS            28896                    404007
H2 TO DESULFURIZERS (FOE) 3635.73                  15752.7
COKE (FOE)                10567.5                  198414
TOTAL                     511531                   6.09911E+06
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"C"

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TIME:05.52.09 DATE:THUJUN211984173 63
REFINERY SIMULATION PROGRAM

CASE:ATLBAS50 REGION:ATLANTIC

**** FEED BLEND ****

          CRUDE ORIGIN              LV %          BPCD

           FRONTIER                 33            44814.9
           VENEZL                   7             9506.18
           ARABL                    30.6          41555.6
           SYNCRUDE                 15            20370.4
           MEXL                     9.9           13444.5
           NORTHSEA                 4.5           6111.12
            No.  MBP          LV %        S.G.        API           SULFUR WT%  BPCD          Lbs/hr FEED      Lbs/hr SULFUR
            Total            100                                                135803        1.71583E+06      20635.2
            Average                     .867354     31.6398       1.20263

               **** MATERIAL BALANCE ****


          CRUDE UNIT
           No. Name             BPCD        Lbs/hr         IBP          EBP          S.G.        API          SULFUR WT%  Lbs/hr Su
                          *** FEED ***
           0   CRUDE FEED     135803       1.71583E+06   60           1360         .867351   31.6404        1.20264        20635.2
                          *** PRODUCT ***
           2   OVERHEAD        8573.97      80017.5       60           169.193      .640668   89.3633        .0145574       11.6484
           20  LSR             6389.39      62080.5       60           169.193      .667      80.644         .0187739       11.6549
           3   NAPHTHA         12525.7      132823        169.193      279.565      .727948   62.8821        .0233518       31.0165
           4   KEROSENE        35973.8      423989        279.565      540          .809093   43.3872        .17377         736.766
           5   LGO             16950.6      214952        540          660          .870536   31.0435        .767538        1649.84
           1   REDUCED CRUDE 61778.5        864048        660          1360         .960131   15.8757        2.10705        18205.9


          VACUUM UNIT
           No. Name             BPCD        Lbs/hr         IBP          EBP          S.G.        API          SULFUR WT%  Lbs/hr Su
                          *** FEED ***
           32  REDUCED CRUDE 61778.5        864048        660          1360         .960131   15.8757        2.10705        18205.9
                          *** PRODUCT ***
           6   HVGO            43743.7      586641        660          1050         .920633   22.1986        1.3757         8070.42
           7   RESIDUUM        10034.7      277410        1050         1360         1.05595   2.50256        3.65395        10136.4


          CAT CRACKER
           No. Name             BPCD        Lbs/hr         IBP          EBP          S.G.        API          SULFUR WT%  Lbs/hr Su
                          *** FEED ***
           65  LGO             352.266      4467.12       540          660          .870536   31.0435        .767538        34.2868
           64  HVGO            43680.7      585796        660          1050         .920633   22.1986        1.3757         8058.79
                          *** TOTAL FEED ***
           8   FCCU FEED       44033        590264        540          1050         .920233   22.2654        1.3711         8093.08
                          *** PRODUCT ***
           12  LCO             11378.1      159285        430          650          .961023   15.7389        1.71521        2732.06
           13  HCO             2844.53      43433.5       650          787.375      1.0482    3.49333        2.71003        1177.06
           14  CRACKED GAS     21975.9      239470                                  .748053   57.6572        .100496        432.232
           39  C3/C4 -FCCU     8575.44      70456.9                                 .564024   119.376        0              0
          *** PRODUCT ***
          < 18 > LE FROM CAT CRACKER (FOE)= 2601.86
          AVAILABLE C3/C4 OLEFINS= 8666.71
          CONVERSION Wt%= 65.6563     CONVERSION Vol %= 67.7
          COKE, WT% 8.16897
          COKE  ,0/HR 48243.2          Sulfur in Flue Gas,Lbs/hr= 331.20
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CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 8575.44
*** PRODUCT ***
< 15 > POLYMER= 3501.87
< 16 > LE FROM POLY (FOE)= 2689.24


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 0
< 62 > C3/C4 TO ALKYL= 0
< 20 > I-C4 FR. GAS PLANT= 0
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 0
< 63 > LE FROM ALKYL (FOE)= 0


CATALYTIC REFORMER UNIT
 No. Name         BPCD       Lbs/hr      IBP       EBP       S.G.      API        SULFUR WT%  Lbs/hr Su
             *** FEED ***
 9   REFORMER FEED 9650      102329      169.193   279.565   .727948   62.8821    0           0
             *** PRODUCT ***
 17  REFORMATE    7563.54    86134.9                         .781779   49.4975    0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 1886.38
CONVERSION(LV%)= 78.3787    Severity (RON Clear)= 95.5  FEED KW= 12.1642


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 8573.97
< 57 > LE FROM REFORMER (FOE)= 1886.38
< 18 > LE FROM CAT CRACKER (FOE)= 2681.86
< 16 > LE FROM POLY (FOE)= 2689.24
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 5611.07
< 20 > I-C4 FR. GAS PLANT= 0
< 49 > REF C4 TO BLENDING = 2774.48
< 69 > LSR= 6195.68


ISOMERIZATION UNIT (ONCE THRU)
*** FEED ***
< 69 > LSR= 6195.68
*** PRODUCT ***
< 29 > LSR+ISO= 6138.18


*** BY-PASS= 42 %   ***


GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 6138.18
< 26 > REFORMATE= 7563.54
< 50 > ALKYLATE= 0
< 15 > POLYMER= 3501.87
< 14 > CRACKED GAS= 21975.9
< 49 > REF C4 TO BLENDING = 2774.48
< 60 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 12500
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      < 23 > UNLEADED REGULAR= 26418
      < 24 > UNLEADED PREMIUM= 2956
      < 25 > AVIATION GASOLINE= 0


      *** GASOLINE COMPOSITION ***


                 LR           UR           UP           AV


LSR            .328977      .0756929     0            0
CRACKED GAS    .561135      .55          .130982      0
REFORMATE      .0575586     .170045      .794051      0
POLYMER        0            .132556      0            0
ALKYLATE       0            0            0            .9786
C4             .05233       .071706      .0750476     .0214


       TURBO FUEL BLENDING
       *** FEED ***
       < 30 > LSR= 193.71
       < 58 > NAPHTHA= 1527.75
       < 59 > KEROSENE= 4442.55
       *** PRODUCT ***
       < 42 > JET FUEL B= 1761
       < 43 > JET FUEL A= 4403


       *** TURBO FUEL COMPOSITION ***


                    NAPHTHA BASE  KEROSENE BASE


       LSR           .11          0
       NAPHTHA       .48          .155
       KEROSENE      .41          .845


        DISTILLATE BLENDING
        *** FEED ***
        < 60 > KEROSENE= 31531.3
        < 40 > LGO= 16178.6
        < 38 > LCO= 9278.13
        *** PRODUCT ***
        < 44 > STOVE OIL= 2390
        < 45 > LIGHT FUEL OIL= 26607
        < 46 > DIESEL FUEL= 27991


        *** DISTILLATE COMPOSITION ***


                     STOVE OIL     DIESEL FUEL   LFO


        KEROSENE      1             .607          .456674
        LCO           0             .139          .20248
        LGO           0             .254          .340846
        HEAVY FUEL OIL BLENDING
        *** FEED ***
        < 41 > LGO= 419.738
        < 35 > LCO= 2100
        < 13 > HCO= 2844.53
        < 37 > HVGO= 0
        < 31 > REDUCED CRUDE= 0
        < 34 > VAC RESIDUUM= 8536.73

        *** PRODUCT ***
        < 47 > HEAVY FUEL OIL= 13901


                   OTHER PRODUCTS
        < 27 > NAPHTHA SPECIALTIES= 0
        < 36 > HVGO TO LUBE OIL= 63
        < 48 > RESID TO COKING= 0
        < 33 > VAC RESID TO ASPHALT PLANT= 9498
        < 61 > OLEFIN PETROCHEMICAL FEED= 0
        < 66 > NAPHTHA PETROCHEMICAL FEED= 1348
        < 67 > VGO PETROCHEMICAL FEED= 0


DISTILLATE DESULFURIZATION


        STREAM           TOTAL              FEED  TO  DDS                                FINAL STREAM
                         BPCD       BPCD      Lbs/hr    SULFUR WT%            % BYPASS    SULFUR WT%
        KEROSENE         35973.8    35973.8   423989     .17377               0           8.70287E-03
        LGO              16598.3    16598.3   210485     .767538              2.00039E-04 .0772891
        LCO              11378.1    7964.69   111499     1.71521              29.9998     .641558
        HCO              2844.53    0         0          2.71003              100         2.71003
        VAC RESIDUUM     8536.73    0         0          3.65395              100         3.65395




   ***PRODUCT SLATES & SPECIFICATIONS***


        ______________JET FUEL B   JET FUEL A   STOVE OIL     LFO          DIESEL FUEL   HFO

        BPCD           1761         4403         2390          26607        27991         13901
        S.G.           .754513      .796516      .809093       .860798      .845818       1.03443
        ASTM 10%       206.364      287.448      351.225       379.149      368.337
        ASTM 20%       223.069      319.198      367.718       420.799      398.553
        ASTM 50%       268.337      393.43       415.276       520.339      484.455
        ASTM 90%       471.553      493.673      497.478       609.812      603.379
        RVP,psia       2.63197
        Sulfur Wt %    .0164598     .0107656     8.68848E-03   .173647      .125338       2.94357
        Flash Point,F  64.2404      101.783      129.951       145.66       139.392
        Pour Point,F  -79.9104     -54.4261     -44.234       -32.6327     -35.6808
        Cetane No.                                                          44.9436
        Visc @100F,cs  .794852      1.26406      1.50673       2.58976      2.19642       1291.96
        Visc @122F,cs  .70117       1.09285      1.29152       2.14464      1.83979       488.171
        Watsons K      12.0486      11.856       11.8142       11.4427      11.5497       10.8475
        MeABP          291.291      382.162      413.386       495.629      472.288       952.93
```

```
GASOLINE

                    LEADED REGULAR,BPCD           12580
                    TEL Addition,cc/IG: 1.24
                    RON / MON / (R+M)/2 (Clear)  86.8996 / 78.7256 / 82.8126
                    RON / MON / (R+M)/2          91.5212 / 82.4998 / 87.0105
                    RVP,psia                     11.0166


                    MMT Addition,mg/l: 0
                    UNLEADED REGULAR,BPCD        26418
                    RON / MON / (R+M)/2          92.055 / 81.952 / 87.0035
                    RVP,psia                     10.1215


                    UNLEADED PREMIUM,BPCD        2956

                    RON / MON / (R+M)/2          95 / 85.2263 / 90.1132
                    RVP,psia                     9.86518


                    AVIATION GASOLINE,BPCD       0
                    RON / MON / (R+M)/2          93 / 90.8 / 91.9
                    RVP,psia                     10
```

STREAMS

```
< 0 > CRUDE FEED= 135803                          < 1 > REDUCED CRUDE= 61778.5
< 2 > OVERHEAD= 8573.97                           < 3 > NAPHTHA= 12525.7
< 4 > KEROSENE= 35973.8                           < 5 > LGO= 16950.6
< 6 > HVGO= 43743.7                               < 7 > RESIDUUM= 18034.7
< 8 > FCCU FEED= 44033                            < 9 > REFORMER FEED= 9650
< 10 > CAT POLY FEED= 8575.44                     < 11 > ALKYLATION FEED= 0
< 12 > LCO= 11378.1                               < 13 > HCO= 2844.53
< 14 > CRACKED GAS= 21975.9                       < 15 > POLYMER= 3501.87
< 16 > LE FROM POLY (FOE)= 2689.24                < 17 > REFORMATE= 7563.54
< 18 > LE FROM CAT CRACKER (FOE)= 2681.86         < 19 > FUEL GAS (FOE)= 5611.07
< 20 > I-C4 FR. GAS PLANT= 0                      < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 12580                      < 23 > UNLEADED REGULAR= 26418
< 24 > UNLEADED PREMIUM= 2956                     < 25 > AVIATION GASOLINE= 0
< 26 > REFORMATE= 7563.54                         < 27 > NAPHTHA SPECIALTIES= 0
< 28 > LSR= 6389.39                               < 29 > LSR+ISO= 6138.18
< 30 > LSR= 193.71                                < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 61778.5                     < 33 > VAC RESID TO ASPHALT PLANT= 9498
< 34 > VAC RESIDUUM= 8536.73                      < 35 > LCO= 2100
< 36 > HVGO TO LUBE OIL= 63                       < 37 > HVGO= 0
< 38 > LCO= 9278.13                               < 39 > C3/C4 -FCCU= 8575.44
< 40 > LGO= 16178.6                               < 41 > LGO= 419.738
< 42 > JET FUEL B= 1761                           < 43 > JET FUEL A= 4403
< 44 > STOVE OIL= 2390                            < 45 > LIGHT FUEL OIL= 26607
< 46 > DIESEL FUEL= 27991                         < 47 > HEAVY FUEL OIL= 13901
< 48 > RESID TO COKING= 0                         < 49 > REF C4 TO BLENDING = 2774.48
< 50 > ALKYLATE= 0                                < 51 > CRUDE LIGHT ENDS= 1.60865
< 52 > TOTAL PRODUCT= 129916                      < 53 > C2 % IN CRUDE FEED= .02451
< 54 > C3 % IN CRUDE FEED= .31962                 < 55 > I-C4 % IN CRUDE FEED= .19662
< 56 > N-C4 % IN CRUDE FEED= 1.0679               < 57 > LE FROM REFORMER (FOE)= 1886.38
< 58 > NAPHTHA= 1527.75                           < 59 > KEROSENE= 4442.55
< 60 > KEROSENE= 31531.3                          < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 0                          < 63 > LE FROM ALKYL (FOE)= 0
< 64 > HVGO= 43680.7                              < 65 > LGO = 352.266
< 66 > NAPHTHA PETROCHEMICAL FEED= 1348           < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                             < 69 > LSR= 6195.68
```

LIGHT ENDS BALANCE

*** FROM ***

	CRUDE UNIT	REFORMER	CAT CRACKER	POLY	ALKYL	ISO	TOTAL
C2 ,#/HR	174.540	1478.38	8297.84	0	0	0	9950.77
C3 ,#/HR	3211.99	3855.73	7414.29	7571.56	0	132.959	22186.5
IC4 ,#/HR	2197.53	2305.79	17525.9	18750.5	0	236.596	41016.3
NC4 ,#/HR	12358.9	3365.06	7072.01	6997.53	0	673.708	30467.2
H2 ,#/HR	0	3710.54	3226.79	0	0	0	6937.33
C1 ,#/HR	0	1478.38	3440.57	0	0	0	4918.95
H2S ,#/HR	0	0	3634.22	0	0	0	3634.22
C2= ,#/HR	0	0	5059.66	0	0	0	5059.66
C3= ,#/HR	0	0	17527.9	0	0	0	17527.9
C4= ,#/HR	0	0	26709.1	0	0	0	26709.1
TOTAL ,#/HR	17943	16193.9	99908.3	33319.6	0	1043.26	168408
BPCD (FOE)	1449.53	1886.38	8246.57	2689.24	0	84.1455	14355.9

*** TO ***

	POLY	ALKY	GAS BLEND	PC FEED	DDS	FUEL GAS	TOTAL
C2 ,#/HR	0	0	0	0	0	9950.77	9950.77
C3 ,#/HR	6162.42	0	0	0	0	16024.1	22186.5
IC4 ,#/HR	17341.3	0	11599.3	0	0	12075.7	41016.3
NC4 ,#/HR	6997.53	0	11498.7	0	0	11971	30467.2
H2 ,#/HR	0	0	0	0	5469.5	1467.83	6937.33
C1 ,#/HR	0	0	0	0	0	4918.95	4918.95
H2S ,#/HR	0	0	0	0	0	3634.22	3634.22
C2= ,#/HR	0	0	0	0	0	5059.66	5059.66
C3= ,#/HR	13527.8	0	0	0	0	4000.08	17527.9
C4= ,#/HR	26427.8	0	137.808	0	0	143.471	26709.1
TOTAL ,#/HR	70456.9	0	23235.8	0	5469.5	69245.7	168408
BPCD (FOE)	5613.94	0	1868.48	0	1262.36	5611.07	14355.9

```
                                **** OVERALL MASS BALANCE ****
*** FEED ***


                                BPCD                         #/HR


CRUDE                            135003                        1.71583E+06
BUTANE                          0                             0
TOTAL                            135003                        1.71583E+06




*** PRODUCT ***


FUEL GAS (FOE)                  5611.07                       69245.7
MOTOR GASOLINE                  41954                         445133
AVIATION TURBO FUELS            6164                          70442.5
DISTILLATES                     56988                         706678
HEAVY FUEL OIL                  13901                         209468
OTHER PRODUCTS                  10909                         161238
H2 TO DESULFURIZERS (FOE)       1262.36                       5469.5
COKE (FOE)                      2569.43                       48243.2
TOTAL                           139359                        1.71592E+06
```

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TIME:00.30.22 DATE:WEDJUN271984179 62
REFINERY SIMULATION PROGRAM

CASE:ATLBAS51 REGION:ATLANTIC

#### FEED BLEND ####

           CRUDE ORIGIN             LV %          BPCD

            FRONTIER                33            44737.5
            VENEZL                  7             9489.77
            ARABL                   30.6          41483.9
            SYNCRUDE                15            20335.2
            MEXL                    9.9           13421.2
            NORTHSEA                4.5           6100.57
              No.  MBP          LV %        S.G.        API          SULFUR WT%  BPCD          Lbs/hr FEED      Lbs/hr SULFUR
              Total            100                                              135568          1.71287E+06     20599.6
              Average                     .867354     31.6398       1.20263



                #### MATERIAL BALANCE ####


            CRUDE UNIT
              No. Name          BPCD         Lbs/hr        IBP          EBP          S.G.        API           SULFUR WT%  Lbs/hr Su
                         ### FEED ###
              0   CRUDE FEED    135568       1.71287E+06   60           1360         .867355     31.6396       1.20264      20599.6
                         ### PRODUCT ###
              2   OVERHEAD      8585.66      80152.1       60           169.481      .640872     89.2929       .0146255     11.7227
              28  LSR           6404.85      62243.1       60           169.481      .667132     80.6019       .0187767     11.6872
              3   NAPHTHA       12525.7      132849        169.481      279.941      .720092     62.0436       .0233882     31.071
              4   KEROSENE      35863.6      422732        279.941      540          .809173     43.3699       .173948      735.334
              5   LGO           16921.3      214581        540          660          .870536     31.0435       .767538      1646.99
              1   REDUCED CRUDE 61671.8      862556        660          1360         .960131     15.8757       2.10705      18174.5


            VACUUM UNIT
              No. Name          BPCD         Lbs/hr        IBP          EBP          S.G.        API           SULFUR WT%  Lbs/hr Su
                         ### FEED ###
              32  REDUCED CRUDE 61671.8      862556        660          1360         .960131     15.8757       2.10705      18174.5
                         ### PRODUCT ###
              6   HVGO          43668        585626        660          1050         .920633     22.1986       1.3757       8056.45
              7   RESIDUUM      10003.8      276935        1050         1360         1.05595     2.50256       3.65395      10119.1


            CAT CRACKER
              No. Name          BPCD         Lbs/hr        IBP          EBP          S.G.        API           SULFUR WT%  Lbs/hr Su
                         ### FEED ###
              65  LGO           0            0             540          660          .870536     31.0435       .767538      0
              64  HVGO          43605        584781        660          1050         .920633     22.1986       1.3757       8044.83
                         ### TOTAL FEED ###
              8   FCCU FEED     43605        584781        540          1050         .920633     22.1986       1.3757       8044.83
                         ### PRODUCT ###
              12  LCO           11232.6      157384        430          650          .961855     15.6116       1.72389      2713.12
              13  HCO           2808.16      42905.6       650          787.002      1.04887     3.40709       2.72375      1168.64
              14  CRACKED GAS   21765.4      237176                                  .748055     57.6572       .180951      429.172
              39  C3/C4 -FCCU   8593.93      70615.3                                 .564075     119.353       0            0
            ### PRODUCT ###
            < 18 > LE FROM CAT CRACKER (FOE)= 2613.95
            AVAILABLE C3/C4 OLEFINS= 8593.93
            CONVERSION Wt%= 65.7496      CONVERSION Vol %= 67.8
            COKE, WT% 8.23475
            COKE ,0/HR 48180            Sulfur in Flue Gas,Lbs/hr= 330.135
```

```
CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 8593.93
*** PRODUCT ***
< 15 > POLYMER= 3508.34
< 16 > LE FROM POLY (FOE)= 2696.49


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 0
< 62 > C3/C4 TO ALKYL= 0
< 20 > I-C4 FR. GAS PLANT= 0
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 0
< 63 > LE FROM ALKYL (FOE)= 0


CATALYTIC REFORMER UNIT
 No. Name          BPCD       Lbs/hr       IBP        EBP        S.G.       API        SULFUR WT%  Lbs/hr Su
          *** FEED ***
 9  REFORMER FEED 9650        102349       169.481    279.941    .720092    62.8436    0           0
          *** PRODUCT ***
 17  REFORMATE    7700.91     87270.7                            .777958    50.3865    0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 1745.99
CONVERSION(LV%)= 79.8022    Severity (RON Clear)= 94    FEED KW= 12.1635


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 8585.66
< 57 > LE FROM REFORMER (FOE)= 1745.99
< 18 > LE FROM CAT CRACKER (FOE)= 2613.95
< 16 > LE FROM POLY (FOE)= 2696.49
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 5321.57
< 20 > I-C4 FR. GAS PLANT= 0
< 49 > REF C4 TO BLENDING = 2768.2
< 69 > LSR= 6211.14


ISOMERIZATION UNIT (ONCE THRU)
*** FEED ***
< 69 > LSR= 6211.14
*** PRODUCT ***
< 29 > LSR+ISO= 6211.14


*** BY-PASS= 100 %   ***


GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 6211.14
< 26 > REFORMATE= 7700.91
< 50 > ALKYLATE= 0
< 15 > POLYMER= 3508.34
< 14 > CRACKED GAS= 21765.4
< 49 > REF C4 TO BLENDING = 2768.2
< 60 > IMPORTED C4= 0
```

```
      *** PRODUCT ***
      ( 22 ) LEADED REGULAR= 4195
      ( 23 ) UNLEADED REGULAR= 34003
      ( 24 ) UNLEADED PREMIUM= 2956
      ( 25 ) AVIATION GASOLINE= 0

      *** GASOLINE COMPOSITION ***


             LR           UR           UP           AV


LSR          .24037       .15033       0            0
CRACKED GAS  .70012       .541         0            0
REFORMATE    0            .141089      .934621      0
POLYMER      0            .100006      0            0
ALKYLATE     0            0            0            .9786
C4           .0595102     .0659756     .0653794     .0214


      TURBO FUEL BLENDING
      *** FEED ***
      ( 30 ) LSR= 193.71
      ( 58 ) NAPHTHA= 1527.75
      ( 59 ) KEROSENE= 4442.55
      *** PRODUCT ***
      ( 42 ) JET FUEL B= 1761
      ( 43 ) JET FUEL A= 4403


      *** TURBO FUEL COMPOSITION ***


                    NAPHTHA BASE  KEROSENE BASE


      LSR           .11           0
      NAPHTHA       .48           .155
      KEROSENE      .41           .845


      DISTILLATE BLENDING
      *** FEED ***
      ( 60 ) KEROSENE= 31421.1
      ( 40 ) LGO= 16909.3
      ( 38 ) LCO= 8657.65
      *** PRODUCT ***
      ( 44 ) STOVE OIL= 2390
      ( 45 ) LIGHT FUEL OIL= 26607
      ( 46 ) DIESEL FUEL= 27991


      *** DISTILLATE COMPOSITION ***


                    STOVE OIL     DIESEL FUEL   LFO


      KEROSENE      1             .607          .452531
      LCO           0             .139          .17916
      LGO           0             .254          .368309
```

```
HEAVY FUEL OIL BLENDING
### FEED ###
< 41 > LGO= 12.0339
< 35 > LCO= 2575
< 13 > HCO= 2808.16
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 8505.81
### PRODUCT ###
< 47 > HEAVY FUEL OIL= 13901

                 OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 0
< 36 > HVGO TO LUBE OIL= 63
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 9498
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 1348
< 67 > VGO PETROCHEMICAL FEED= 0


DISTILLATE DESULFURIZATION


       STREAM          TOTAL              FEED  TO  DDS                                 FINAL STREAM
                        BPCD       BPCD      Lbs/hr    SULFUR WT%         % BYPASS     SULFUR WT%
       KEROSENE        35863.6    35863.6   422732     .173948           0            8.7118E-03
       LGO             16921.3    16921.3   214581     .767538           0            .0772877
       LCO             11232.6    7862.85   110169     1.72389           29.9997      .644839
       HCO             2808.16    0         0          2.72375           100          2.72375
       VAC RESIDUUM    8505.81    0         0          3.65395           100          3.65395




    ###PRODUCT SLATES & SPECIFICATIONS###


                 JET FUEL B    JET FUEL A    STOVE OIL      LFO          DIESEL FUEL   HFO
_____________________________________________________________________________________________

BPCD             1761          4483          2390           26607        27991         13901
S.G.             .75463        .796605       .809173        .859128      .845982       1.03693
ASTM 10%         206.554       287.791       351.545        379.434      368.658
ASTM 20%         223.301       319.517       367.981        421.598      390.803
ASTM 50%         260.663       393.61        415.445        525.194      484.514
ASTM 90%         471.622       493.703       497.508        610.699      603.374
RVP,psia         2.34049
Sulfur Wt %      .0164812      .0107786      8.69738E-03    .160291      .125914       2.94303
Flash Point,F    64.3448       101.974       130.126        145.058      139.568
Pour Point,F    -79.8496      -54.3573      -44.1798       -29.9542     -35.7286
Cetane No.                                                               44.0872
Visc @100F,cs    .795745       1.26556       1.50833        2.61372      2.19865       1224.23
Visc @122F,cs    .701927       1.09409       1.29282        2.16592      1.8415        464.026
Watsons K        12.048        11.8556       11.8138        11.4728      11.5481       10.8112
MeABP            291.527       382.379       413.569        497.598      472.421       948.97
```

LIGHT ENDS BALANCE

*** FROM ***

	CRUDE UNIT	REFORMER	CAT CRACKER	POLY	ALKYL	ISO	TOTAL
C2 ,#/HR	174.246	1340.2	8283.78	0	0	0	9798.23
C3 ,#/HR	3206.44	3555.21	7359.42	7594.22	0	0	21715.3
IC4 ,#/HR	2193.74	2217.46	17368.8	18781.1	0	0	40561.1
NC4 ,#/HR	12337.6	3236.15	7034.07	7034.07	0	0	29641.9
H2 ,#/HR	0	3389.15	3222	0	0	0	6611.15
C1 ,#/HR	0	1340.2	3434.74	0	0	0	4774.94
H2S ,#/HR	0	0	3616.49	0	0	0	3616.49
C2= ,#/HR	0	0	5051.00	0	0	0	5051.00
C3= ,#/HR	0	0	17317.5	0	0	0	17317.5
C4= ,#/HR	0	0	26522.9	0	0	0	26522.9
TOTAL ,#/HR	17912	15078.4	99210.8	33409.4	0	0	165611
BPCD (FOE)	1447.03	1745.99	8191.51	2696.5	0	0	14081

*** TO ***

	POLY	ALKY	GAS BLEND	PC FEED	DDS	FUEL GAS	TOTAL
C2 ,#/HR	0	0	0	0	0	9798.23	9798.23
C3 ,#/HR	6181.92	0	0	0	0	15533.4	21715.3
IC4 ,#/HR	17368.8	0	11735	0	0	11457.3	40561.1
NC4 ,#/HR	7034.07	0	11439.2	0	0	11168.6	29641.9
H2 ,#/HR	0	0	0	0	5498.94	1112.21	6611.15
C1 ,#/HR	0	0	0	0	0	4774.94	4774.94
H2S ,#/HR	0	0	0	0	0	3616.49	3616.49
C2= ,#/HR	0	0	0	0	0	5051.00	5051.00
C3= ,#/HR	13507.6	0	0	0	0	3809.9	17317.5
C4= ,#/HR	26522.9	0	0	0	0	0	26522.9
TOTAL ,#/HR	70615.3	0	23174.2	0	5498.94	66322.2	165611
BPCD (FOE)	5626.56	0	1863.75	0	1269.15	5321.57	14081

```
                               **** OVERALL MASS BALANCE ****
*** FEED ***


                               BPCD                          #/HR


CRUDE                           135568                        1.71287E+06
BUTANE                         0                              0
TOTAL                           135568                        1.71287E+06




*** PRODUCT ***


FUEL GAS (FOE)                 5321.57                        66322.2
MOTOR GASOLINE                 41954                          445187
AVIATION TURBO FUELS           6164                           70451.2
DISTILLATES                    56988                          706101
HEAVY FUEL OIL                 13901                          209974
OTHER PRODUCTS                 10909                          161240
H2 TO DESULFURIZERS (FOE)      1269.15                        5498.94
COKE (FOE)                     2566.07                        48100
TOTAL                          139073                         1.71295E+06
```

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TIME:02.29.00 DATE:SUNJUL 11984183 76
REFINERY SIMULATION PROGRAM

CASE:QUEBAS50 REGION:QUEBEC

#### FEED BLEND ####

           CRUDE ORIGIN              LV %           BPCD

            FRONTIER                16.8           46386.1
            VENEZH                  11.65          32166.6
            ARABH                   6.95           19189.5
            CANDMH                  27.3           75377.4
            SYNCRUDE                16.3           45005.6
            MEXH                    11.6           32028.5
            CONDENSA                9.4            25954.1
              No.  MBP          LV %        S.G.        API         SULFUR WT%  BPCD         Lbs/hr FEED     Lbs/hr SULFUR
              Total            100                                              276108       3.55714E+06     64227
              Average                     .884407     28.4943      1.80558
                 #### MATERIAL BALANCE ####


           CRUDE UNIT
             No. Name          BPCD        Lbs/hr        IBP         EBP         S.G.       API          SULFUR WT%  Lbs/hr Su
                         ### FEED ###
             0   CRUDE FEED    276108      3.55714E+06   60          1460        .884406    28.4943      1.80558     64227
                         ### PRODUCT ###
             2   OVERHEAD      23786.7     222347        60          169.511     .641693    89.0103      .0405176    90.0898
             28  LSR           18703.7     180503        60          169.511     .662502    82.0843      .0498476    89.9765
             3   NAPHTHA       35981.3     387899        169.511     318.491     .740068    59.6987      .0838934    325.422
             4   KEROSENE      50363.3     606375        318.491     540         .826527    39.6983      .422624     2562.69
             5   LGO           32193.2     415002        540         660         .884944    28.3971      1.02294     4245.22
             1   REDUCED CRUDE 133783      1.92552E+06   660         1460        .988044    11.7123      2.96043     57003.6


           VACUUM UNIT
             No. Name          BPCD        Lbs/hr        IBP         EBP         S.G.       API          SULFUR WT%  Lbs/hr Su
                         ### FEED ###
             32  REDUCED CRUDE 133783      1.92552E+06   660         1460        .988044    11.7123      2.96043     57003.6
                         ### PRODUCT ###
             6   HVGO          86654.2     1.18759E+06   660         1050        .940819    18.9009      1.9963      23707.8

             7   RESIDUUM      47129.2     737932        1050        1460        1.07487    .143829      4.51195     33295.1


           CAT CRACKER
             No. Name          BPCD        Lbs/hr        IBP         EBP         S.G.       API          SULFUR WT%  Lbs/hr Su
                         ### FEED ###
             65  LGO           7966.8      102700        540         660         .884944    28.3971      1.02294     1050.56
             64  HVGO          80553.2     1.10397E+06   660         1050        .940819    18.9009      1.9963      22038.6
                         ### TOTAL FEED ###
             8   FCCU FEED     88520       1.20667E+06   540         1050        .93579     19.7091      1.91346     23089.2
                         ### PRODUCT ###
             12  LCO           15225.4     222092        430         650         1.00137    9.8064       3.11412     6916.22
             13  HCO           3806.36     60653.7       650         743.727     1.0939     -2.1463      4.92031     2984.35
             14  CRACKED GAS   46410.4     509837                                .754129    56.1337      .212507     1083.44
             39  C3/C4 -FCCU   19924.5     164397                                .566419    118.315      0           0
           ### PRODUCT ###
           < 18 > LE FROM CAT CRACKER (FOE)= 8616.09
           AVAILABLE C3/C4 OLEFINS= 20505.5
           CONVERSION Wt%= 76.5602     CONVERSION Vol %= 78.5
           COKE, WT% 12.9445
           COKE ,#/HR 136279          Sulfur in Flue Gas,Lbs/hr= 1199.12
```

```
CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 17500
*** PRODUCT ***
< 15 > POLYMER= 7031.94
< 16 > LE FROM POLY (FOE)= 5636.06


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 3487
< 62 > C3/C4 TO ALKYL= 2424.48
< 20 > I-C4 FR. GAS PLANT= 1062.52
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 2460.84
< 63 > LE FROM ALKYL (FOE)= 328.006


CATALYTIC REFORMER UNIT
  No. Name          BPCD       Lbs/hr       IBP        EBP        S.G.       API        SULFUR WT%  Lbs/hr Su
            *** FEED ***
 9   REFORMER FEED 32600       351447       169.511    318.491    .740068   59.6987      0           0
            *** PRODUCT ***
 17  REFORMATE     26993.8     308364                             .784206   48.9373      0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 4928.54
CONVERSION(LV%)= 82.8031    Severity (RON Clear)= 92    FEED KW= 12.0564


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 23786.7
< 57 > LE FROM REFORMER (FOE)= 4928.54
< 18 > LE FROM CAT CRACKER (FOE)= 8616.09
< 16 > LE FROM POLY (FOE)= 5636.06
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 16731.9
< 20 > I-C4 FR. GAS PLANT= 1062.52
< 49 > REF C4 TO BLENDING = 5355.57




< 69 > LSR= 18309.4


ISOMERIZATION UNIT (ONCE THRU)
*** FEED ***
< 69 > LSR= 18309.4
*** PRODUCT ***
< 29 > LSR+ISO= 18100.5


*** BY-PASS= 56 %   ***
```

```
     GASOLINE BLENDING
     *** FEED ***
     < 29 > LSR+ISO= 10100.5
     < 26 > REFORMATE= 9444.81
     < 50 > ALKYLATE= 2460.04
     < 15 > POLYMER= 7031.94
     < 14 > CRACKED GAS= 46410.4
     < 49 > REF C4 TO BLENDING = 5355.57
     < 60 > IMPORTED C4= 0
     *** PRODUCT ***
     < 22 > LEADED REGULAR= 26456
     < 23 > UNLEADED REGULAR= 53805
     < 24 > UNLEADED PREMIUM= 7925
     < 25 > AVIATION GASOLINE= 698


     *** GASOLINE COMPOSITION ***


            LR         UR         UP         AV


LSR         .486292    .0987049   0          0
CRACKED GAS .426165    .545       .733383    0
REFORMATE   .047496    .152104    0          0
POLYMER     0          .130693    0          0
ALKYLATE    0          3.57700E-03 .2        .9786
C4          .0400474   .0697613   .0666176   .0214

     TURBO FUEL BLENDING
     *** FEED ***
     < 30 > LSR= 394.35
     < 58 > NAPHTHA= 3381.3
     < 59 > KEROSENE= 10942.4
     *** PRODUCT ***
     < 42 > JET FUEL B= 3585
     < 43 > JET FUEL A= 11133


     *** TURBO FUEL COMPOSITION ***


                NAPHTHA BASE  KEROSENE BASE


     LSR          .11          0
     NAPHTHA      .555         .125
     KEROSENE     .335         .875


     DISTILLATE BLENDING
     *** FEED ***
     < 60 > KEROSENE= 39420.9
     < 40 > LGO= 13787.9
     < 38 > LCO= 5225.44
```

```
*** PRODUCT ***
< 44 > STOVE OIL= 1384
< 45 > LIGHT FUEL OIL= 20505
< 46 > DIESEL FUEL= 36545


*** DISTILLATE COMPOSITION ***


               STOVE OIL     DIESEL FUEL   LFO


KEROSENE       1             .628          .735742
LCO            0             .05           .165725
LGO            0             .322          .0985328


HEAVY FUEL OIL BLENDING
*** FEED ***
< 41 > LGO= 10438.5
< 35 > LCO= 10000
< 13 > HCO= 3806.36
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 31656.2
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 55901


               OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 17549
< 36 > HVGO TO LUBE OIL= 3774
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 15473
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 0
< 67 > VGO PETROCHEMICAL FEED= 2327

DISTILLATE DESULFURIZATION


     STREAM              TOTAL                 FEED  TO  DDS                                      FINAL STREAM
                          BPCD        BPCD      Lbs/hr     SULFUR WT%          % BYPASS         SULFUR WT%
     KEROSENE            50363.3     50363.3   606375      .422624              0              .0212164
     LGO                 24226.4     24226.4   312302     1.02294               0              .103245
     LCO                 15225.4     12180.4   177675     3.11412              19.9995         .891938
     HCO                  3806.36    0          0         4.92031             100             4.92031
     VAC RESIDUUM        31656.2     0          0         4.51195             100             4.51195
```

```
***PRODUCT SLATES & SPECIFICATIONS***

                 JET FUEL B   JET FUEL A   STOVE OIL    LFO          DIESEL FUEL   HFO
_________________________________________________________________________________________

BPCD             3585         11133        1384         20505        36545         55901
S.G.             .760499      .815719      .826527      .861258      .854079       1.02755
ASTM 10%         206.84       332.442      380.64       390.593      395.689
ASTM 20%         225.329      358.797      393.974      412.285      422.617
ASTM 50%         281.197      424.042      439.559      469.824      496.002
ASTM 90%         469.877      499.58       502.694      575.975      606.465
RVP,psia         2.63795
Sulfur Wt %      .0577002     .0202489     .0211312     .193289      .0900873      3.19785
Flash Point,F    64.4094      126.003      143.508      148.825      151.644




Pour Point,F     -85.2775     -50.6189     -44.8898     -53.3527     -32.0124
Cetane No.                                                           43.4953
Visc @100F,cs    .796577      1.5051       1.72         2.15133      2.44777       584.869
Visc @122F,cs    .702339      1.28886      1.46208      1.79793      2.03596       252.412
Watsons K        11.9531      11.7121      11.6562      11.3152      11.5026       10.8325
MeABP            291.172      412.024      434.212      465.536      488.172       919.2


GASOLINE


                 LEADED REGULAR,BPCD             26456
                 TEL Addition,cc/IG: 1.24
                 RON / MON / (R+M)/2 (Clear)     86.4154 / 79.0141 / 82.7148
                 RON / MON / (R+M)/2             91.1409 / 82.888 / 87.0145
                 RVP,psia                        12.1096


                 MMT Addition,mg/l: 0
                 UNLEADED REGULAR,BPCD           53805
                 RON / MON / (R+M)/2             92 / 82.0197 / 87.0099
                 RVP,psia                        10.2628


                 UNLEADED PREMIUM,BPCD           7925
                 RON / MON / (R+M)/2             94.2704 / 85.7463 / 90.0084
                 RVP,psia                        9.73036


                 AVIATION GASOLINE,BPCD          698
                 RON / MON / (R+M)/2             93 / 90.8 / 91.9
                 RVP,psia                        10
```

STREAMS

```
< 0 > CRUDE FEED= 276100                      < 1 > REDUCED CRUDE= 133783
< 2 > OVERHEAD= 23786.7                       < 3 > NAPHTHA= 35981.3
< 4 > KEROSENE= 50363.3                       < 5 > LGO= 32193.2
< 6 > HVGO= 86654.2                           < 7 > RESIDUUM= 47129.2
< 8 > FCCU FEED= 88520                        < 9 > REFORMER FEED= 32600
< 10 > CAT POLY FEED= 17500                   < 11 > ALKYLATION FEED= 3487
< 12 > LCO= 15225.4                           < 13 > HCO= 3806.36
< 14 > CRACKED GAS= 46410.4                   < 15 > POLYMER= 7031.94
< 16 > LE FROM POLY (FOE)= 5636.06            < 17 > REFORMATE= 26993.8
< 18 > LE FROM CAT CRACKER (FOE)= 8616.09     < 19 > FUEL GAS (FOE)= 16731.9
< 20 > I-C4 FR. GAS PLANT= 1062.52            < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 26456                  < 23 > UNLEADED REGULAR= 53805
< 24 > UNLEADED PREMIUM= 7925                 < 25 > AVIATION GASOLINE= 698
< 26 > REFORMATE= 9444.81                     < 27 > NAPHTHA SPECIALTIES= 17549
< 28 > LSR= 18703.7                           < 29 > LSR+ISO= 18100.5
< 30 > LSR= 394.35                            < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 133783                  < 33 > VAC RESID TO ASPHALT PLANT= 15473
< 34 > VAC RESIDUUM= 31656.2                  < 35 > LCO= 10000
< 36 > HVGO TO LUBE OIL= 3774                 < 37 > HVGO= 0
< 38 > LCO= 5225.44                           < 39 > C3/C4 -FCCU= 19924.5
< 40 > LGO= 13787.9                           < 41 > LGO= 10438.5
< 42 > JET FUEL B= 3585                       < 43 > JET FUEL A= 11133
< 44 > STOVE OIL= 1384                        < 45 > LIGHT FUEL OIL= 20505




< 46 > DIESEL FUEL= 36545                     < 47 > HEAVY FUEL OIL= 55901
< 48 > RESID TO COKING= 0                     < 49 > REF C4 TO BLENDING = 5355.57
< 50 > ALKYLATE= 2460.84                      < 51 > CRUDE LIGHT ENDS= 1.84100
< 52 > TOTAL PRODUCT= 257060                  < 53 > C2 % IN CRUDE FEED= .04423
< 54 > C3 % IN CRUDE FEED= .277635            < 55 > I-C4 % IN CRUDE FEED= .21544
< 56 > N-C4 % IN CRUDE FEED= 1.30377          < 57 > LE FROM REFORMER (FOE)= 4928.54
< 58 > NAPHTHA= 3381.3                        < 59 > KEROSENE= 10942.4
< 60 > KEROSENE= 39420.9                      < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 2424.48                < 63 > LE FROM ALKYL (FOE)= 320.006
< 64 > HVGO= 80553.2                          < 65 > LGO = 7966.8
< 66 > NAPHTHA PETROCHEMICAL FEED= 0          < 67 > VGO PETROCHEMICAL FEED= 2327
< 68 > IMPORTED C4= 0                         < 69 > LSR= 10309.4
```

LIGHT ENDS BALANCE

*** FROM ***

	CRUDE UNIT	REFORMER	CAT CRACKER	POLY	ALKYL	ISO	TOTAL
C2 ,#/HR	640.41	3599.56	27663.8	0	0	0	31903.8
C3 ,#/HR	5672.63	10026.8	18675.7	16276.2	1854.84	298.076	52804.2
IC4 ,#/HR	4895.59	6729.54	40855.2	37755	0	530.415	90765.8
NC4 ,#/HR	30677.6	9821.07	18499.8	15788.3	2187.34	1510.36	78484.5
H2 ,#/HR	0	9305.69	10788.7	0	0	0	20094.4
C1 ,#/HR	0	3599.56	11470.4	0	0	0	15070
H2S ,#/HR	0	0	11587.7	0	0	0	11587.7
C2= ,#/HR	0	0	16868.2	0	0	0	16868.2
C3= ,#/HR	0	0	33945.3	0	0	0	33945.3
C4= ,#/HR	0	0	67671.4	0	0	0	67671.4
TOTAL ,#/HR	41886.2	43082.2	258026	69819.5	4042.18	2338.85	419195
BPCD (FOE)	3382.33	4928.54	21557.5	5636.06	328.006	188.643	36021.1

*** TO ***

	POLY	ALKY	GAS BLEND	PC FEED	DDS	FUEL GAS	TOTAL
C2 ,#/HR	0	0	0	0	0	31903.8	31903.8
C3 ,#/HR	13388.3	1854.83	0	0	0	37561.2	52804.2
IC4 ,#/HR	34867	13575.1	18187.7	0	0	24135.9	90765.8
NC4 ,#/HR	15788.3	2187.34	26002.5	0	0	34506.4	78484.5
H2 ,#/HR	0	0	0	0	8097.38	11997	20094.4
C1 ,#/HR	0	0	0	0	0	15070	15070
H2S ,#/HR	0	0	0	0	0	11587.7	11587.7
C2= ,#/HR	0	0	0	0	0	16868.2	16868.2
C3= ,#/HR	22596.5	3130.56	0	0	0	8218.23	33945.3
C4= ,#/HR	57752.8	8001.17	823.93	0	0	1093.53	67671.4
TOTAL ,#/HR	144393	28749	45014.1	0	8097.38	192942	419195
BPCD (FOE)	11504.5	2296.13	3619.67	0	1868.88	16731.9	36021.1

```
                        **** OVERALL MASS BALANCE ****
*** FEED ***


                        BPCD                      #/HR


CRUDE                    276100                    3.55714E+06
BUTANE                   0                         0
TOTAL                    276100                    3.55714E+06




*** PRODUCT ***


FUEL GAS (FOE)           16731.9                   192942
MOTOR GASOLINE           89604                     936383
AVIATION TURBO FUELS     14718                     172004
DISTILLATES              58434                     728588
HEAVY FUEL OIL           55901                     836744
OTHER PRODUCTS           39123                     526356
H2 TO DESULFURIZERS (FOE) 1068.08                  8097.38
COKE (FOE)               8323.42                   156279
TOTAL                    283904                    3.55739E+06
```

```
TIME:02.22.44 DATE:THUJUN141984166 63
REFINERY SIMULATION PROGRAM

CASE:QUEBA651 REGION:QUEBEC

#### FEED BLEND ####

            CRUDE ORIGIN              LV %          BPCD

             FRONTIER                 16.8          46397.4
             VENEZH                   11.65         32174.4
             ARABH                    6.95          19194.2
             CANDNH                   27.3          75395.8
             SYNCRUDE                 16.3          45016.5
             MEXH                     11.6          32036.3
             CONDENSA                 9.4           25960.4
              No.  MBP          LV %        S.G.        API          SULFUR WT%  BPCD         Lbs/hr FEED     Lbs/hr SULFUR
              Total             100                                              276175       3.55801E+06     64242.6
              Average                       .884407     28.4942      1.00558

                #### MATERIAL BALANCE ####


             CRUDE UNIT
              No. Name          BPCD        Lbs/hr        IBP          EBP         S.G.        API            SULFUR WT%  Lbs/hr Su
                          ### FEED ###
              0   CRUDE FEED    276175      3.55801E+06   60           1460        .884408     28.494         1.00558      64242.6
                          ### PRODUCT ###
              2   OVERHEAD      23866.4     223157        60           169.856     .64188      88.9461        .0404668     90.3047
              28  LSR           18782.2     181304        60           169.856     .66266      82.0333        .0498625     90.4027
              3   NAPHTHA       36381.3     392476        169.856      320.418     .740567     59.5698        .0845112     331.686
              4   KEROSENE      49910.3     601283        320.418      540         .827025     39.5952        .42521       2556.72
              5   LGO           32201       415102        540          660         .884944     28.3971        1.02294      4246.25
              1   REDUCED CRUDE 133816      1.92599E+06   660          1460        .988044     11.7123        2.96043      57017.6
             VACUUM UNIT
              No. Name          BPCD        Lbs/hr        IBP          EBP         S.G.        API            SULFUR WT%  Lbs/hr Su
                          ### FEED ###
              32  REDUCED CRUDE 133816      1.92599E+06   660          1460        .988044     11.7123        2.96043      57017.6
                          ### PRODUCT ###
              6   HVGO          86674.4     1.18786E+06   660          1050        .940819     18.9009        1.9963       23713.3
              7   RESIDUUM      47141.5     738124        1050         1460        1.07487     .143829        4.51195      33303.8


             CAT CRACKER
              No. Name          BPCD        Lbs/hr        IBP          EBP         S.G.        API            SULFUR WT%  Lbs/hr Su
                          ### FEED ###
              65  LGO           7871.6      101473        540          660         .884944     28.3971        1.02294      1038
              64  HVGO          80573.4     1.10425E+06   660          1050        .940819     18.9009        1.9963       22044.2
                          ### TOTAL FEED ###
              8   FCCU FEED     88445       1.20572E+06   540          1050        .935846     19.7001        1.91438      23082.2
                          ### PRODUCT ###
              12  LCO           15495.6     225943        430          650         1.00097     9.86289        3.07501      6947.78
              13  HCO           3873.89     61667.7       650          745.415     1.0928      -2.01611       4.85852      2996.14
              14  CRACKED GAS   46255.7     507862                                 .75372      56.2355        .21436       1088.65
              39  C3/C4 -FCCU   20111.9     165944                                 .566421     118.314        0            0
             ### PRODUCT ###
             < 18 > LE FROM CAT CRACKER (FOE)= 8285.71
             AVAILABLE C3/C4 OLEFINS= 20350.2
             CONVERSION Wt%= 76.1462     CONVERSION Vol %= 78.1
             COKE, WT% 12.0274
             COKE  ,0/HR 154743          Sulfur in Flue Gas,Lbs/hr= 1109.36
```

```
CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 18500
*** PRODUCT ***
< 15 > POLYMER= 7433.57
< 16 > LE FROM POLY (FOE)= 5958.32


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 2318.42
< 62 > C3/C4 TO ALKYL= 1611.95
< 20 > I-C4 FR. GAS PLANT= 706.477
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 1636.09
< 63 > LE FROM ALKYL (FOE)= 218.135


CATALYTIC REFORMER UNIT
 No. Name           BPCD        Lbs/hr        IBP         EBP         S.G.        API          SULFUR WT%  Lbs/hr Su
           *** FEED ***
 9   REFORMER FEED 33000        355999        169.856     320.418     .740567  59.5698         0            0
           *** PRODUCT ***
 17  REFORMATE     27333.6      312446                                .784700  48.8218         0            0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 4982.09
CONVERSION(LV%)= 82.8291    Severity (RON Clear)= 92    FEED KW= 12.0541


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 23866.4
< 57 > LE FROM REFORMER (FOE)= 4982.09








< 18 > LE FROM CAT CRACKER (FOE)= 8285.71
< 16 > LE FROM POLY (FOE)= 5958.32
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 16691.9
< 20 > I-C4 FR. GAS PLANT= 706.477
< 49 > REF C4 TO BLENDING = 5306.26
< 69 > LSR= 18387.8


ISOMERIZATION UNIT (ONCE THRU)
*** FEED ***
< 69 > LSR= 18387.8
*** PRODUCT ***
< 29 > LSR+ISO= 18387.8


*** BY-PASS= 100 %   ***
```

```
        GASOLINE BLENDING
        *** FEED ***
        < 29 > LSR+ISO= 18387.8
        < 26 > REFORMATE= 9784.62
        < 50 > ALKYLATE= 1636.09
        < 15 > POLYMER= 7433.57
        < 14 > CRACKED GAS= 46255.7
        < 49 > REF C4 TO BLENDING = 5386.26
        < 60 > IMPORTED C4= 0
        *** PRODUCT ***
        < 22 > LEADED REGULAR= 8820
        < 23 > UNLEADED REGULAR= 71441
        < 24 > UNLEADED PREMIUM= 7925
        < 25 > AVIATION GASOLINE= 698


        *** GASOLINE COMPOSITION ***


                     LR             UR              UP             AV


LSR             .348019        .214419         0              0
CRACKED GAS     .157901        .55             .702893        0
REFORMATE       .444848        .0692065        .115695        0
POLYMER         0              .104052         0              0
ALKYLATE        0              1.13334E-03     .11            .9786
C4              .0492319       .0611898        .0714124       .0214


        TURBO FUEL BLENDING
        *** FEED ***
        < 30 > LSR= 394.35
        < 58 > NAPHTHA= 3381.3
        < 59 > KEROSENE= 10942.4
        *** PRODUCT ***
        < 42 > JET FUEL B= 3585
        < 43 > JET FUEL A= 11133


        *** TURBO FUEL COMPOSITION ***


                          NAPHTHA BASE  KEROSENE BASE


        LSR              .11            0
        NAPHTHA          .555           .125
        KEROSENE         .335           .875


        DISTILLATE BLENDING
        *** FEED ***
        < 60 > KEROSENE= 38968
        < 40 > LGO= 13970.8
        < 38 > LCO= 5495.56
        *** PRODUCT ***
        < 44 > STOVE OIL= 1384
        < 45 > LIGHT FUEL OIL= 20505
        < 46 > DIESEL FUEL= 36545
```

```
*** DISTILLATE COMPOSITION ***


            STOVE OIL    DIESEL FUEL   LFO


KEROSEKE      1            .628          .713651
LCO           0            .05           .178899
LGO           0            .322          .10745


HEAVY FUEL OIL BLENDING
*** FEED ***
< 41 > LGO= 10358.6
< 35 > LCO= 10000
< 13 > HCO= 3873.89
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 31668.5
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 55901


             OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 17549
< 36 > HVGO TO LUBE OIL= 3774
< 40 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 15473
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 0
< 67 > VGO PETROCHEMICAL FEED= 2327


DISTILLATE DESULFURIZATION


                                                                                    FINAL STREAM
    STREAM             TOTAL               FEED  TO  DDS                                    
                        BPCD        BPCD       Lbs/hr    SULFUR WT%       % BYPASS    SULFUR WT%
    KEROSENE          49910.3     49910.3     601283      .42521           0          .0213467
    LGO               24329.4     24329.4     313630     1.02294           0          .103245
    LCO               15495.6     12396.5     180755     3.07501          19.9999     .000493
    HCO                3873.89    0           0          4.05052         100          4.05052
    VAC RESIDUUM      31668.5     0           0          4.51195         100          4.51195
```

```
***PRODUCT SLATES & SPECIFICATIONS***

                  JET FUEL B   JET FUEL A   STOVE OIL    LFO          DIESEL FUEL   HFO
                  ______________________________________________________________________

BPCD              3585         11133        1384         20505        36545         55901
S.G.              .76096       .816217      .827025      .864366      .854372       1.0277
ASTM 10%          207.098      334.007      382.421      393.375      397.616

ASTM 20%          225.908      360.391      395.607      415.917      424.085
ASTM 50%          282.554      425.278      440.554      473.065      496.392
ASTM 90%          470.493      499.795      502.903      500.934      606.438
RVP,psia          2.37957
Sulfur Wt %       .0581636     .020434      .0212605     .204145      .0974784      3.19775
Flash Point,F     64.5479      127.679      143.383      149.145      151.442
Pour Point,F     -84.9798     -50.2741     -44.576      -53.5457     -31.7375
Cetane No.                                                            43.4414
Visc @100F,cs     .800424      1.51519      1.73159      2.20082      2.46073       589.618
Visc @122F,cs     .705599      1.29705      1.47138      1.84234      2.04607       254.097
Watsons K         11.9512      11.7101      11.6539      11.2094      11.5018       10.8318
MeABP             292.186      413.168      435.31       469.205      488.955       919.52


GASOLINE


          LEADED REGULAR,BPCD             8820
          TEL Addition,cc/IG: 1.24
          RON / MON / (R+M)/2 (Clear)     86.3617 / 78.3661 / 82.3639
          RON / MON / (R+M)/2             91.4082 / 82.7184 / 87.0633
          RVP,psia                        10.8445


          MMT Addition,mg/l: 18
          UNLEADED REGULAR,BPCD           71441
          RON / MON / (R+M)/2             92.13 / 82.1577 / 87.1439
          RVP,psia                        10.4339


          UNLEADED PREMIUM,BPCD           7925
          RON / MON / (R+M)/2             95.0399 / 85.258 / 90.149
          RVP,psia                        9.73252


          AVIATION GASOLINE,BPCD          698
          RON / MON / (R+M)/2             93 / 90.8 / 91.9
          RVP,psia                        10
```

STREAMS

```
< 0 > CRUDE FEED= 276175                  < 1 > REDUCED CRUDE= 133816
< 2 > OVERHEAD= 23866.4                   < 3 > NAPHTHA= 36381.3
< 4 > KEROSENE= 49910.3                   < 5 > LGO= 32201
< 6 > HVGO= 86674.4                       < 7 > RESIDUUM= 47141.5
< 8 > FCCU FEED= 88445                    < 9 > REFORMER FEED= 33000
< 10 > CAT POLY FEED= 18500               < 11 > ALKYLATION FEED= 2318.42
< 12 > LCO= 15495.6                       < 13 > HCO= 3873.89
< 14 > CRACKED GAS= 46255.7               < 15 > POLYMER= 7433.57
< 16 > LE FROM POLY (FOE)= 5958.32        < 17 > REFORMATE= 27333.6
< 18 > LE FROM CAT CRACKER (FOE)= 8285.71 < 19 > FUEL GAS (FOE)= 16691.9
< 20 > I-C4 FR. GAS PLANT= 706.477        < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 8820               < 23 > UNLEADED REGULAR= 71441
< 24 > UNLEADED PREMIUM= 7925             < 25 > AVIATION GASOLINE= 698
< 26 > REFORMATE= 9784.62                 < 27 > NAPHTHA SPECIALTIES= 17549
< 28 > LSR= 18782.2                       < 29 > LSR+ISO= 18387.8
< 30 > LSR= 394.35                        < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 133816              < 33 > VAC RESID TO ASPHALT PLANT= 15473



< 34 > VAC RESIDUUM= 31668.5              < 35 > LCO= 10000
< 36 > HVGO TO LUBE OIL= 3774             < 37 > HVGO= 0
< 38 > LCO= 5495.56                       < 39 > C3/C4 -FCCU= 20111.9
< 40 > LGO= 13970.8                       < 41 > LGO= 10358.6
< 42 > JET FUEL B= 3585                   < 43 > JET FUEL A= 11133
< 44 > STOVE OIL= 1384                    < 45 > LIGHT FUEL OIL= 20505
< 46 > DIESEL FUEL= 36545                 < 47 > HEAVY FUEL OIL= 55901
< 48 > RESID TO COKING= 0                 < 49 > REF C4 TO BLENDING = 5386.26
< 50 > ALKYLATE= 1636.09                  < 51 > CRUDE LIGHT ENDS= 1.84108
< 52 > TOTAL PRODUCT= 257860              < 53 > C2 % IN CRUDE FEED= .04423
< 54 > C3 % IN CRUDE FEED= .277635        < 55 > I-C4 % IN CRUDE FEED= .21544
< 56 > N-C4 % IN CRUDE FEED= 1.30377      < 57 > LE FROM REFORMER (FOE)= 4982.09
< 58 > NAPHTHA= 3381.3                    < 59 > KEROSENE= 10942.4
< 60 > KEROSENE= 38968                    < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 1611.95            < 63 > LE FROM ALKYL (FOE)= 218.135
< 64 > HVGO= 80573.4                      < 65 > LGO = 7871.6
< 66 > NAPHTHA PETROCHEMICAL FEED= 0      < 67 > VGO PETROCHEMICAL FEED= 2327
< 68 > IMPORTED C4= 0                     < 69 > LSR= 18387.8
```

```
                            LIGHT ENDS BALANCE


                                 *** FROM ***
              CRUDE UNIT    REFORMER     CAT CRACKER   POLY        ALKYL       ISO        TOTAL
C2   ,#/HR     640.566       3637.37      27294.6       0           0           0          31572.5
C3   ,#/HR     5674.01       10137.5      18520.4       17195.6     1232.29     0          52759.8
IC4  ,#/HR     4896.78       6804.33      40539.7       39906.9     0           0          92147.7
NC4  ,#/HR     30685         9930.21      18380.4       16709.3     1455.92     0          77160.8
H2   ,#/HR     0             9405.72      10638.5       0           0           0          20044.2
C1   ,#/HR     0             3637.37      11317.3       0           0           0          14954.7
H2S  ,#/HR     0             0            11539         0           0           0          11539
C2=  ,#/HR     0             0            16643.1       0           0           0          16643.1
C3=  ,#/HR     0             0            33699.5       0           0           0          33699.5
C4=  ,#/HR     0             0            67147.8       0           0           0          67147.8
TOTAL  ,#/HR   41896.4       43552.5      255720        73811.8     2688.21     0          417669
BPCD (FOE)     3383.14       4982.09      21351.1       5958.32     218.135     0          35892.8


                                 *** TO ***
              POLY          ALKY         GAS BLEND     PC FEED     DDS         FUEL GAS   TOTAL
C2   ,#/HR     0             0            0             0           0           31572.5    31572.5
C3   ,#/HR     14142.7       1232.29      0             0           0           37384.8    52759.8
IC4  ,#/HR     36853.9       9025.48      19724.4       0           0           26543.9    92147.7
NC4  ,#/HR     16709.3       1455.92      25150.2       0           0           33845.4    77160.8
H2   ,#/HR     0             0            0             0           8129.48     11914.7    20044.2
C1   ,#/HR     0             0            0             0           0           14954.7    14954.7
H2S  ,#/HR     0             0            0             0           0           11539      11539
C2=  ,#/HR     0             0            0             0           0           16643.1    16643.1
C3=  ,#/HR     23895.8       2082.1       0             0           0           7721.64    33699.5
C4=  ,#/HR     61042.9       5318.81      335.083       0           0           451.05     67147.8
TOTAL  ,#/HR   152645        19114.6      45209.7       0           8129.48     192571     417669
BPCD (FOE)     12162         1526.65      3636          0           1876.28     16691.9    35892.8
```

```
                    **** OVERALL MASS BALANCE ****
*** FEED ***


                          BPCD                    #/HR


CRUDE                     276175                  3.55801E+06
BUTANE                    0                       0
TOTAL                     276175                  3.55801E+06




*** PRODUCT ***


FUEL GAS (FOE)            16691.9                 192571
MOTOR GASOLINE            88884                   937674
AVIATION TURBO FUELS      14718                   172189
DISTILLATES               58434                   729682
HEAVY FUEL OIL            55901                   836866
OTHER PRODUCTS            39123                   526404
H2 TO DESULFURIZERS (FOE) 1876.28                 8129.48
COKE (FOE)                8241.61                 154743
TOTAL                     283870                  3.55826E+06
```

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TIME:00.53.12 DATE:FRIJUN221984174 64
REFINERY SIMULATION PROGRAM

CASE:ONTBAS50 REGION:ONTARIO

#### FEED BLEND ####

          CRUDE ORIGIN              LV %            BPCD

           CANDNL                   49              218173
           CANDNH                   9.2             40963.2
           SYNCRUDE                 30.8            137130
           CONDENSA                 11              48977.7
             No.  MBP          LV %        S.G.        API          SULFUR WT%  BPCD         Lbs/hr FEED      Lbs/hr SULFUR
             Total             100                                              445252       5.45458E+06      26309.8
             Average                      .84098      36.7562      .482344

              #### MATERIAL BALANCE.####


           CRUDE UNIT
             No. Name          BPCD         Lbs/hr        IBP          EBP          S.G.      API           SULFUR WT%   Lbs/hr Su
                         ### FEED ###
           0   CRUDE FEED      445538       5.45800E+06   60           1300         .840979   36.7563       .482344      26326.7
                         ### PRODUCT ###
           2   OVERHEAD        54351        500072        60           170.609      .641723   89.0001       .0289118     146.893
           28  LSR             41050.7      399905        60           170.609      .668753   80.0878       .0367421     146.933
           3   NAPHTHA         81358.1      892705        170.609      321.012      .753246   56.3536       .0268000     239.252
           4   KEROSENE        107997       1.31129E+06   321.012      560          .833522   38.2615       .106689      1399
           5   LGO             47930        616654        560          660          .88321    28.711        .312237      1925.42
           1   REDUCED CRUDE 153902         2.12936E+06   660          1300         .949805   17.478        1.06211      22616.1


           VACUUM UNIT
             No. Name          BPCD         Lbs/hr        IBP          EBP          S.G.      API           SULFUR WT%   Lbs/hr Su
                         ### FEED ###
            32  REDUCED CRUDE 153902        2.12936E+06   660          1300         .949805   17.478        1.06211      22616.1
                         ### PRODUCT ###
            6   HVGO           123319       1.65827E+06   660          1050         .923111   21.786        .618341      10253.7
            7   RESIDUUM       30582.8      471098        1050         1300         1.05746   2.31122       2.62443      12363.6


           CAT CRACKER
             No. Name          BPCD         Lbs/hr        IBP          EBP          S.G.      API           SULFUR WT%   Lbs/hr Su
                         ### FEED ###
            65  LGO            29348        377583        560          660          .88321    28.711        .312237      1178.95
            64  HVGO           97152        1.3064E+06    660          1050         .923111   21.786        .618341      8078
                         ### TOTAL FEED ###
            8 - FGCU FEED -    126500       1.68398E+06   560          1050         .913854   23.3387       .549706      9256.96
                         ### PRODUCT ###
            12  LCO            20442.4      287230        430          650          .964558   15.1993       .9444        2712.6
            13  HCO            5110.6       80174.7       650          737.271      1.07695   -.110413      1.49215      1196.33
            14  CRACKED GAS    72060        786560                                  .749328   57.3359       .0543055     427.15
            39  C3/C4 -FCCU    20025.9      164396                                  .563544   119.509       0            0
           ### PRODUCT ###
           < 18 > LE FROM CAT CRACKER (FOE)= 18566.1
           AVAILABLE C3/C4 OLEFINS= 31427
           CONVERSION Wt%= 78.1824      CONVERSION Vol %= 79.8
           COKE, WT% 9.5057
           COKE ,#/HR 161504            Sulfur in Flue Gas,Lbs/hr= 493.035
```

```
CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 1E-06
*** PRODUCT ***
< 15 > POLYMER= 4.00496E-07
< 16 > LE FROM POLY (FOE)= 3.12929E-07


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 29000
< 62 > C3/C4 TO ALKYL= 20025.9

< 20 > I-C4 FR. GAS PLANT= 5752.27
< 21 > I-C4 IMPORTED= 3221.86
*** PRODUCT ***
< 50 > ALKYLATE= 20736.8
< 63 > LE FROM ALKYL (FOE)= 2439.95


CATALYTIC REFORMER UNIT
 No. Name          BPCD       Lbs/hr        IBP        EBP        S.G.       API        SULFUR WT%  Lbs/hr Su
               *** FEED ***
 9   REFORMER FEED 61250      672860        178.609    321.012    .753246    56.3536        0           0
               *** PRODUCT ***
 17  REFORMATE     51294.5    596960                              .790933    45.6113        0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 8612.22
CONVERSION(LV%)= 83.7461    Severity (RON Clear)= 94.5  FEED KW= 11.8537


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 54351
< 57 > LE FROM REFORMER (FOE)= 8612.22
< 18 > LE FROM CAT CRACKER (FOE)= 18566.1
< 16 > LE FROM POLY (FOE)= 3.12929E-07
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 26264.7
< 20 > I-C4 FR. GAS PLANT= 5752.27
< 49 > REF C4 TO BLENDING = 8860.29
< 69 > LSR= 40580.3


ISOMERIZATION UNIT (ONCE THRU)
*** FEED ***
< 69 > LSR= 40580.3
*** PRODUCT ***
< 29 > LSR+ISO= 40320.5


*** BY-PASS= 60 %   ***
```

```
GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 40320.5
< 26 > REFORMATE= 20713.5
< 50 > ALKYLATE= 20736.8
< 15 > POLYMER= 4.00496E-07
< 14 > CRACKED GAS= 72060
< 49 > REF C4 TO BLENDING = 8880.29
< 60 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 51175
< 23 > UNLEADED REGULAR= 104062
< 24 > UNLEADED PREMIUM= 15340
< 25 > AVIATION GASOLINE= 126


 *** GASOLINE COMPOSITION ***


                LR          UR          UP          AV


LSR             .584177     .100183     0           0
CRACKED GAS     .383247     .4          .705141     0
REFORMATE       3.81656E-08 .275926     0           0







POLYMER         0           3.92551E-12 0           0
ALKYLATE        0           .164165     .23         .9786
C4              .032576     .0597252    .064859     .0214

   TURBO FUEL BLENDING
   *** FEED ***
   < 30 > LSR= 470.47
   < 58 > NAPHTHA= 4823.08
   < 59 > KEROSENE= 18600.5
   *** PRODUCT ***
   < 42 > JET FUEL B= 4277
   < 43 > JET FUEL A= 19625


   *** TURBO FUEL COMPOSITION ***


                    NAPHTHA BASE  KEROSENE BASE


   LSR              .11           0
   NAPHTHA          .6            .115
   KEROSENE         .29           .885
```

```
DISTILLATE BLENDING
*** FEED ***
< 60 > KEROSENE= 89388.1
< 40 > LGO= 18580.5
< 38 > LCO= 14497.4
*** PRODUCT ***
< 44 > STOVE OIL= 2264
< 45 > LIGHT FUEL OIL= 38243
< 46 > DIESEL FUEL= 81959


*** DISTILLATE COMPOSITION ***


              STOVE OIL     DIESEL FUEL   LFO


KEROSENE      1             .8            .563683
LCO           0             .1            .164775
LGO           0             .1            .271542


HEAVY FUEL OIL BLENDING
*** FEED ***
< 41 > LGO= 1.55762
< 35 > LCO= 5945
< 13 > HCO= 5110.6
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 22216.8
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 33274


              OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 22581
< 36 > HVGO TO LUBE OIL= 10882
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 8366
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285
< 67 > VGO PETROCHEMICAL FEED= 15285
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DISTILLATE DESULFURIZATION


     STREAM           TOTAL                      FEED  TO  DDS                                        FINAL STREAM
                       BPCD         BPCD         Lbs/hr        SULFUR WT%           % BYPASS     SULFUR WT%
     KEROSENE          107997       107997       1.31129E+06  .106609              0            5.33986E-03
     LGO               18582        18582        239071        .312237              0            .0313117
     LCO               20442.4      18398.2      250588        .9444                9.99981      .100818
     HCO               5110.6       0            0             1.49215              100          1.49215
     VAC RESIDUUM      22216.8      0            0             2.62443              100          2.62443
```

```
***PRODUCT SLATES & SPECIFICATIONS***


                 JET FUEL B   JET FUEL A   STOVE OIL    LFO          DIESEL FUEL   HFO
                 ____________________________________________________________________

BPCD             4277         19625        2264         38243        81959         33274
S.G.             .767232      .82429       .833522      .860606      .851594       1.04384
ASTM 10%         207.036      344.665      384.044      402.533      391.207
ASTM 20%         224.623      360.079      398.987      433.921      412.112
ASTM 50%         274.043      432.208      447.709      512.361      472.43
ASTM 90%         470.745      516.902      519.506      600.724      569.951
RVP,psia         2.60473
Sulfur Wt %      .0209900     7.59029E-03  5.33443E-03  .0443393     .0277391      2.04124
Flash Point,F    64.56        133.6        144.286      154.17       147.969
Pour Point,F    -95.5545     -50.3315     -44.7721     -36.6558     -44.291
Cetane No.                                                           40.7048
Visc @100F,cs    .777936      1.61401      1.82367      2.6834       2.13064       1736.00
Visc @122F,cs    .686099      1.37624      1.54433      2.21393      1.79140       612.827
Watsons K        11.8172      11.6398      11.5968      11.3546      11.4481       10.7677
MeABP            285.29       423.238      443.160      499.382      466.610       960.06


GASOLINE


                 LEADED REGULAR,BPCD            51175
                 TEL Addition,cc/IG: 1.24
                 RON / MON / (R+M)/2 (Clear)    84.7964 / 78.7772 / 81.0868
                 RON / MON / (R+M)/2            90.4661 / 83.6788 / 87.0725
                 RVP,psia                       12.4795


                 MMT Addition,mg/l: 0
                 UNLEADED REGULAR,BPCD          104062
                 RON / MON / (R+M)/2            91.0908 / 83.0834 / 87.0871
                 RVP,psia                       10.249


                 UNLEADED PREMIUM,BPCD          15340
                 RON / MON / (R+M)/2            94.1481 / 85.8703 / 90.0092
                 RVP,psia                       9.0178


                 AVIATION GASOLINE,BPCD         126
                 RON / MON / (R+M)/2            93 / 90.8 / 91.9
                 RVP,psia                       10
```

STREAMS

```
< 0 > CRUDE FEED= 445530                    < 1 > REDUCED CRUDE= 153982
< 2 > OVERHEAD= 54351                       < 3 > NAPHTHA= 81350.1
< 4 > KEROSENE= 107997                      < 5 > LGO= 47930
< 6 > HVGO= 123319                          < 7 > RESIDUUM= 30582.0
< 8 > FCCU FEED= 126500                     < 9 > REFORMER FEED= 61250
< 10 > CAT POLY FEED= 1E-06                 < 11 > ALKYLATION FEED= 29000
< 12 > LCO= 20442.4                         < 13 > HCO= 5110.6
< 14 > CRACKED GAS= 72060                   < 15 > POLYMER= 4.08496E-07
< 16 > LE FROM POLY (FOE)= 3.12929E-07      < 17 > REFORMATE= 51294.5
< 18 > LE FROM CAT CRACKER (FOE)= 10566.1   < 19 > FUEL GAS (FOE)= 26264.7
< 20 > I-C4 FR. GAS PLANT= 5752.27          < 21 > I-C4 IMPORTED= 3221.06
< 22 > LEADED REGULAR= 51175                < 23 > UNLEADED REGULAR= 104062
< 24 > UNLEADED PREMIUM= 15340              < 25 > AVIATION GASOLINE= 126
< 26 > REFORMATE= 20713.5                   < 27 > NAPHTHA SPECIALTIES= 22581
< 28 > LSR= 41050.7                         < 29 > LSR+ISO= 40320.5
< 30 > LSR= 470.47                          < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 153982                < 33 > VAC RESID TO ASPHALT PLANT= 8366
< 34 > VAC RESIDUUM= 22216.8                < 35 > LCO= 5945
< 36 > HVGO TO LUBE OIL= 10082              < 37 > HVGO= 0
< 38 > LCO= 14497.4                         < 39 > C3/C4 -FCCU= 20025.9
< 40 > LGO= 10500.5                         < 41 > LGO= 1.55762
< 42 > JET FUEL B= 4277                     < 43 > JET FUEL A= 19625
< 44 > STOVE OIL= 2264                      < 45 > LIGHT FUEL OIL= 30243
< 46 > DIESEL FUEL= 81959                   < 47 > HEAVY FUEL OIL= 33274
< 48 > RESID TO COKING= 0                   < 49 > REF C4 TO BLENDING = 8000.29
< 50 > ALKYLATE= 20736.0                    < 51 > CRUDE LIGHT ENDS= 2.90522
< 52 > TOTAL PRODUCT= 422752                < 53 > C2 % IN CRUDE FEED= .00660
< 54 > C3 % IN CRUDE FEED= .69156           < 55 > I-C4 % IN CRUDE FEED= .36344
< 56 > N-C4 % IN CRUDE FEED= 1.04354        < 57 > LE FROM REFORMER (FOE)= 8612.22
< 58 > NAPHTHA= 4823.00                     < 59 > KEROSENE= 10600.5
< 60 > KEROSENE= 89300.1                    < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 20025.9              < 63 > LE FROM ALKYL (FOE)= 2439.95
< 64 > HVGO= 97152                          < 65 > LGO = 29340
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285    < 67 > VGO PETROCHEMICAL FEED= 15285
< 68 > IMPORTED C4= 0                       < 69 > LSR= 40500.3
```

```
                              LIGHT ENDS BALANCE


                                  *** FROM ***
               CRUDE UNIT    REFORMER     CAT CRACKER   POLY          ALKYL        ISO          TOTAL
C2   ,#/HR      2025.19       5950.2       35976.7      0             0            0             43952.1
C3   ,#/HR     22800.6       17072.3       27337.3      0             14632.6      600.588       82443.4
IC4  ,#/HR     13326.5       12089.6       64358.1      0             0            1068.72       90842.9
NC4  ,#/HR     69996.8       17643.5       24202.8      0             15422.5      3043.19       130309
H2   ,#/HR     0             16394         14640.4      0             0            0             31034.4
C1   ,#/HR     0             5950.2        14917.2      0             0            0             20867.4
H2S  ,#/HR     0             0             4704.58      0             0            0             4704.58




C2=  ,#/HR     0             0             21937        0             0            0             21937
C3=  ,#/HR     0             0             64720.3      0             0            0             64720.3
C4=  ,#/HR     0             0             95982.9      0             0            0             95982.9
TOTAL  ,#/HR   108149        75099.8       368777       3.87704E-06   30055.1      4712.5        586794
BPCD (FOE)     8745.1        8612.22       31682.2      3.12929E-07   2439.95      300.092       51779.5


                                  *** TO ***
               POLY          ALKY          GAS BLEND    PC FEED       DDS          FUEL GAS     TOTAL
C2   ,#/HR     0             0             0            0             0            43952.1      43952.1
C3   ,#/HR     0             14632.7       0            0             0            67810.7      82443.4
IC4  ,#/HR     0             88351.4       1244.86      0             0            1246.63      90842.9
NC4  ,#/HR     0             15422.5       57398.6      0             0            57487.7      130309
H2   ,#/HR     0             0             0            0             10931.5      20102.9      31034.4
C1   ,#/HR     0             0             0            0             0            20867.4      20867.4
H2S  ,#/HR     0             0             0            0             0            4704.58      4704.58
C2=  ,#/HR     0             0             0            0             0            21937        21937
C3=  ,#/HR     0             32168         0            0             0            32552.3      64720.3
C4=  ,#/HR     0             61162.2       17396.9      0             0            17423.8      95982.9
TOTAL  ,#/HR   8.20915E-06   211737        76040.4      0             10931.5      288085       586794
BPCD (FOE)     6.54125E-07   16901.4       6090.43      0             2522.99      26264.7      51779.5
```

```
                          **** OVERALL MASS BALANCE ****
   *** FEED ***


                          BPCD                    #/HR







   CRUDE                  445538                  5.45808E+06
   BUTANE                 3221.06                 26515.9
   TOTAL                  448760                  5.4846E+06





   *** PRODUCT ***


   FUEL GAS (FOE)         26264.7                 208085
   MOTOR GASOLINE         170711                  1.79550E+06
   AVIATION TURBO FUELS   23902                   283447
   DISTILLATES            122466                  1.52809E+06
   HEAVY FUEL OIL         33274                   505952
   OTHER PRODUCTS         72399                   911251
   H2 TO DESULFURIZERS (FOE) 2522.99              10931.5
   COKE (FOE)             8601.7                  161504
   TOTAL                  460141                  5.40485E+06
```

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TIME:01.59.44 DATE:SUNJUN171984169 66
REFINERY SIMULATION PROGRAM

CASE:ONTBAS51 REGION:ONTARIO

**** FEED BLEND ****

          CRUDE ORIGIN             LV %          BPCD

           CANDNL                  49            218092
           CANDNH                  9.2           40947.8
           SYNCRUDE                30.8          137086
           CONDENSA                11            48959.4
             No.  MBP        LV %       S.G.        API         SULFUR WT%  BPCD        Lbs/hr FEED     Lbs/hr SULFUR
             Total           100                                             445085       5.45254E+06     26300
             Average                  .84098      36.7562      .482344

               **** MATERIAL BALANCE ****


          CRUDE UNIT
            No. Name         BPCD        Lbs/hr        IBP         EBP         S.G.        API            SULFUR WT%  Lbs/hr Su
                         *** FEED ***
           0   CRUDE FEED   445085      5.45254E+06   60          1300        .84098      36.756         .482344      26300
                         *** PRODUCT ***
           2   OVERHEAD     53625.7     500570        60          169.258     .640799     89.3181        .0289229     144.779
           28  LSR          40330.9     392505        60          169.258     .66796      80.339         .0368951     144.815
           3   NAPHTHA      81108.1     889216        169.258     319.402     .752615     56.5111        .0267354     237.735
           4   KEROSENE     108724      1.31953E+06   319.402     560         .833148     38.3378        .10616       1400.81
           5   LGO          47881.4     616029        560         660         .88321      28.711         .312237      1923.47
           1   REDUCED CRUDE 153746     2.1272E+06    660         1300        .949005     17.478         1.06211      22593.2


          VACUUM UNIT
            No. Name     .   BPCD        Lbs/hr        IBP         EBP         S.G.        API            SULFUR WT%  Lbs/hr Su
                         *** FEED ***
           32  REDUCED CRUDE 153746     2.1272E+06    660         1300        .949005     17.478         1.06211      22593.2
                         *** PRODUCT ***
           6   HVGO         123198      1.65664E+06   660         1050        .923111     21.786         .618341      10243.7
           7   RESIDUUM     30548       470562        1050        1300        1.05746     2.31122        2.62443      12349.6


          CAT CRACKER
            No. Name         BPCD        Lbs/hr        IBP         EBP         S.G.        API            SULFUR WT%  Lbs/hr Su
                         *** FEED ***
          65  LGO           29806.8     383486        560         660         .88321      28.711         .312237      1197.39
          64  HVGO          97030.6     1.30477E+06   660         1050        .923111     21.786         .618341      8067.91
                         *** TOTAL FEED ***
          8   FCCU FEED     126837      1.68825E+06   560         1050        .913734     23.3591        .548812      9265.29
                         *** PRODUCT ***
          12  LCO           20294       285155        430         650         .96459      15.1945        .949982      2708.92
          13  HCO           5073.49     79626.6       650         736.428     1.07741     -.164519       1.50097      1195.17
          14  CRACKED GAS   72419.1     790614                                .749448     57.3057        .0539486     426.525
          39  C3/C4 -FCCU   20026.4     164397                                .563534     119.594        0            0
          *** PRODUCT ***
          < 10 > LE FROM CAT CRACKER (FOE)= 10770.2
          AVAILABLE C3/C4 OLEFINS= 31621.5
          CONVERSION Wt%= 70.393      CONVERSION Vol %= 80
          COKE, WT% 9.5913
          COKE  ,0/HR 162009          Sulfur in Flue Gas,Lbs/hr= 493.255
```

```
CAT POLY UNIT
*** FEED ***

< 10 > CAT POLY FEED= 1E-06
*** PRODUCT ***
< 15 > POLYMER= 4.00498E-07
< 16 > LE FROM POLY (FOE)= 3.12916E-07


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 29000
< 62 > C3/C4 TO ALKYL= 20026.4
< 20 > I-C4 FR. GAS PLANT= 5635.77
< 21 > I-C4 IMPORTED= 3337.84
*** PRODUCT ***
< 50 > ALKYLATE= 20737.6
< 63 > LE FROM ALKYL (FOE)= 2439.02


CATALYTIC REFORMER UNIT
 No. Name          BPCD       Lbs/hr       IBP        EBP        S.G.      API         SULFUR WT%  Lbs/hr Su
             *** FEED ***
 9  REFORMER FEED 61000     668764       169.258    319.402   .752615  56.5111        0           0
             *** PRODUCT ***
 17 REFORMATE     51351.4   597262                            .79844   45.7205        0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 8204.98
CONVERSION(LV%)= 84.1826    Severity (RON Clear)= 94    FEED KW= 11.8562


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 53625.7
< 57 > LE FROM REFORMER (FOE)= 8204.98
< 18 > LE FROM CAT CRACKER (FOE)= 18770.2
< 16 > LE FROM POLY (FOE)= 3.12916E-07
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 25740.3
< 20 > I-C4 FR. GAS PLANT= 5635.77
< 49 > REF C4 TO BLENDING = 8915.43
< 69 > LSR= 39868.5


ISOMERIZATION UNIT (ONCE THRU)
*** FEED ***
< 69 > LSR= 39868.5
*** PRODUCT ***
< 29 > LSR+ISO= 39868.5


*** BY-PASS= 100 %   ***
```

```
      GASOLINE BLENDING
      *** FEED ***
      < 29 > LSR+ISO= 39868.5
      < 26 > REFORMATE= 28770.4
      < 50 > ALKYLATE= 20737.6
      < 15 > POLYMER= 4.08498E-07
      < 14 > CRACKED GAS= 72419.1
      < 49 > REF C4 TO BLENDING = 8915.43
      < 68 > IMPORTED C4= 0
      *** PRODUCT ***
      < 22 > LEADED REGULAR= 17058
      < 23 > UNLEADED REGULAR= 138179
      < 24 > UNLEADED PREMIUM= 15348

      < 25 > AVIATION GASOLINE= 126


      *** GASOLINE COMPOSITION ***


                 LR          UR          UP          AV


LSR              .436652     .236492     0           0
CRACKED GAS      .519215     .46         0           0
REFORMATE        0           .124683     .752004     0
POLYMER          0           2.9563E-12  0           0
ALKYLATE         0           .126971     .2          .9786
C4               .0441333    .0518542    .0479963    .0214


      TURBO FUEL BLENDING
      *** FEED ***
      < 30 > LSR= 470.47
      < 58 > NAPHTHA= 4823.08
      < 59 > KEROSENE= 18608.5
      *** PRODUCT ***
      < 42 > JET FUEL B= 4277
      < 43 > JET FUEL A= 19625


      *** TURBO FUEL COMPOSITION ***


                NAPHTHA BASE  KEROSENE BASE


      LSR           .11          0
      NAPHTHA       .6           .115
      KEROSENE      .29          .885


      DISTILLATE BLENDING
      *** FEED ***
      < 60 > KEROSENE= 98116
      < 40 > LGO= 16556.1
      < 38 > LCO= 15794
      *** PRODUCT ***
      < 44 > STOVE OIL= 2264
      < 45 > LIGHT FUEL OIL= 38243
      < 46 > DIESEL FUEL= 81959
```

```
*** DISTILLATE COMPOSITION ***


                    STOVE OIL     DIESEL FUEL   LFO


KEROSENE            1             .71           .775595
LCO                 0             .14           .112954
LGO                 0             .15           .111451

HEAVY FUEL OIL BLENDING
*** FEED ***
< 41 > LGO= 1518.53
< 35 > LCO= 4500
< 13 > HCO= 5073.49
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 22182
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 33274




                 OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 22581
< 36 > HVGO TO LUBE OIL= 10082
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 8366
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285
< 67 > VGO PETROCHEMICAL FEED= 15285

DISTILLATE DESULFURIZATION


          STREAM           TOTAL                  FEED  TO  DDS                                    FINAL STREAM
                            BPCD         BPCD        Lbs/hr      SULFUR WT%         % BYPASS       SULFUR WT%
          KEROSENE         100724        100724      1.31953E+06  .10616            0              5.31336E-03
          LGO              10074.6       10074.6     232543       .312237          -1.00059E-05    .0313117
          LCO              20294         18264.6     256639       .949982           10             .181396
          HCO              5073.49       0           0            1.50097           100            1.50097
          VAC RESIDUUM     22182         0           0            2.62443           100            2.62443
```

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***PRODUCT SLATES & SPECIFICATIONS***


                 JET FUEL B   JET FUEL A   STOVE OIL     LFO           DIESEL FUEL   HFO
________________________________________________________________________________________

BPCD             4277         19625        2264          38243         81959         33274
S.G.             .766658      .823886      .833148       .853574       .859059       1.03999
ASTM 10%         206.26       343.175      382.385       390.5         393.234
ASTM 20%         223.575      366.576      397.488       412.648       418.231
ASTM 50%         273.446      431.248      446.841       475.04        484.559
ASTM 90%         470.033      516.742      519.336       577.549       592.404
RVP,psia         2.43894
Sulfur Wt %      .0209562     7.55899E-03  5.30801E-03   .0306586      .036944       2.0399
Flash Point,F    64.1324      132.767      144.408       148.765       150.275
Pour Point,F    -95.8209     -50.6906     -45.1355      -44.3254      -43.1612
Cetane No.                                                             39.7747
Visc @100F,cs    .773847      1.60405      1.81235       2.17592       2.31032       1747.32
Visc @122F,cs    .682638      1.3682       1.53527       1.82044       1.92494       621.553
Watsons K        11.8202      11.6409      11.5977       11.4316       11.3937       10.8144
MeABP            284.181      422.194      442.153       469.061       477.7         962.74


GASOLINE


             LEADED REGULAR,BPCD             17058
             TEL Addition,cc/IG: 1.24
             RON / MON / (R+M)/2 (Clear)     85.9286 / 78.2615 / 82.0951
             RON / MON / (R+M)/2             91.1183 / 82.7953 / 86.9568
             RVP,psia                        11.2313


             MMT Addition,mg/l: 18
             UNLEADED REGULAR,BPCD           138179
             RON / MON / (R+M)/2             90.8678 / 83.2098 / 87.0388
             RVP,psia                        10.5686


             UNLEADED PREMIUM,BPCD           15348
             RON / MON / (R+M)/2             94.7087 / 85.3494 / 90.0291
             RVP,psia                        9.74816

             AVIATION GASOLINE,BPCD          126
             RON / MON / (R+M)/2             93 / 90.8 / 91.9
             RVP,psia                        10
```

STREAMS

```
< 0 > CRUDE FEED= 445005                          < 1 > REDUCED CRUDE= 153746
< 2 > OVERHEAD= 53625.7                           < 3 > NAPHTHA= 81100.1
< 4 > KEROSENE= 100724                            < 5 > LGO= 47081.4
< 6 > HVGO= 123198                                < 7 > RESIDUUM= 30548
< 8 > FCCU FEED= 126837                           < 9 > REFORMER FEED= 61000
< 10 > CAT POLY FEED= 1E-06                       < 11 > ALKYLATION FEED= 29000
< 12 > LCO= 20294                                 < 13 > HCO= 5073.49
< 14 > CRACKED GAS= 72419.1                       < 15 > POLYMER= 4.00498E-07
< 16 > LE FROM POLY (FOE)= 3.12916E-07            < 17 > REFORMATE= 51351.4
< 18 > LE FROM CAT CRACKER (FOE)= 18770.2         < 19 > FUEL GAS (FOE)= 25740.3
< 20 > I-C4 FR. GAS PLANT= 5635.77                < 21 > I-C4 IMPORTED= 3337.04
< 22 > LEADED REGULAR= 17058                      < 23 > UNLEADED REGULAR= 138179
< 24 > UNLEADED PREMIUM= 15348                    < 25 > AVIATION GASOLINE= 126
< 26 > REFORMATE= 28770.4                         < 27 > NAPHTHA SPECIALTIES= 22581
< 28 > LSR= 40338.9                               < 29 > LSR+ISO= 39868.5
< 30 > LSR= 470.47                                < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 153746                      < 33 > VAC RESID TO ASPHALT PLANT= 8366
< 34 > VAC RESIDUUM= 22182                        < 35 > LCO= 4500
< 36 > HVGO TO LUBE OIL= 10082                    < 37 > HVGO= 0
< 38 > LCO= 15794                                 < 39 > C3/C4 -FCCU= 20026.4
< 40 > LGO= 16556.1                               < 41 > LGO= 1518.53
< 42 > JET FUEL B= 4277                           < 43 > JET FUEL A= 19625
< 44 > STOVE OIL= 2264                            < 45 > LIGHT FUEL OIL= 38243
< 46 > DIESEL FUEL= 81959                         < 47 > HEAVY FUEL OIL= 33274
< 48 > RESID TO COKING= 0                         < 49 > REF C4 TO BLENDING = 8915.43
< 50 > ALKYLATE= 20737.6                          < 51 > CRUDE LIGHT ENDS= 2.98522
< 52 > TOTAL PRODUCT= 422752                      < 53 > C2 % IN CRUDE FEED= .00668
< 54 > C3 % IN CRUDE FEED= .69156                 < 55 > I-C4 % IN CRUDE FEED= .36344
< 56 > N-C4 % IN CRUDE FEED= 1.84354              < 57 > LE FROM REFORMER (FOE)= 8204.98
< 58 > NAPHTHA= 4823.08                           < 59 > KEROSENE= 18600.5
< 60 > KEROSENE= 90116                            < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 20026.4                    < 63 > LE FROM ALKYL (FOE)= 2439.02
< 64 > HVGO= 97030.6                              < 65 > LGO = 29006.8
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285          < 67 > VGO PETROCHEMICAL FEED= 15285
< 68 > IMPORTED C4= 0                             < 69 > LSR= 39868.5
```

LIGHT ENDS BALANCE

```
                              *** FROM ***
                CRUDE UNIT   REFORMER    CAT CRACKER  POLY         ALKYL      ISO     TOTAL
C2  ,#/HR       2023.13      5427.31     36229.4      0            0          0       43679.8
C3  ,#/HR       22777.4      16056.6     27510.3      0            14635      0       80979.3
IC4  ,#/HR      13313        11760.1     64771        0            0          0       89844.1
NC4  ,#/HR      69925.8      17162.6     24329.8      0            15408.4    0       126827
H2  ,#/HR       0            15667.9     14744.3      0            0          0       30412.2
C1  ,#/HR       0            5427.31     15021.9      0            0          0       20449.2
H2S  ,#/HR      0            0           4719.01      0            0          0       4719.01
C2=  ,#/HR      0            0           22091.1      0            0          0       22091.1
C3=  ,#/HR      0            0           65150.9      0            0          0       65150.9
C4=  ,#/HR      0            0           96553.9      0            0          0       96553.9
TOTAL  ,#/HR    108039       71501.8     371122       3.07688E-06  30043.4    0       580706
BPCD (FOE)      8736.22      8204.99     31806.2      3.12916E-07  2439.01    0       51186.4


                              *** TO ***
                POLY         ALKY        GAS BLEND    PC FEED      DDS        FUEL GAS  TOTAL
C2  ,#/HR       0            0           0            0            0          43679.8   43679.8
C3  ,#/HR       0            14635       0            0            0          66344.3   80979.3
IC4  ,#/HR      0            87402.9     1248.79      0            0          1192.41   89844.1
NC4  ,#/HR      0            15408.5     56996.2      0            0          54422     126827
H2  ,#/HR       0            0           0            0            10862.7    19549.5   30412.2
C1  ,#/HR       0            0           0            0            0          20449.2   20449.2
H2S  ,#/HR      0            0           0            0            0          4719.01   4719.01
C2=  ,#/HR      0            0           0            0            0          22091.1   22091.1
C3=  ,#/HR      0            32183.7     0            0            0          32967.2   65150.9
C4=  ,#/HR      0            61149.1     18111.4      0            0          17293.4   96553.9
TOTAL  ,#/HR    8.209E-06    210779      76356.4      0            10862.7    282708    580706
BPCD (FOE)      6.54114E-07  16824.5     6114.5       0            2507.1     25740.3   51186.4
```

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                         **** OVERALL MASS BALANCE ****
*** FEED ***


                         BPCD                    #/HR


CRUDE                    445085                  5.45254E+06
BUTANE                   3337.84                 27470.4
TOTAL                    448423                  5.48001E+06




*** PRODUCT ***


FUEL GAS (FOE)           25740.3                 282700
MOTOR GASOLINE           170711                  1.79773E+06
AVIATION TURBO FUELS     23902                   283296
DISTILLATES              122466                  1.52867E+06
HEAVY FUEL OIL           33274                   504086
OTHER PRODUCTS           72399                   910948
H2 TO DESULFURIZERS (FOE) 2507.1                 10862.7
COKE (FOE)               8628.6                  162009
TOTAL                    459628                  5.48026E+06
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TIME:02.45.38 DATE:SATJUN161984168 65
REFINERY SIMULATION PROGRAM

CASE:WESBAS50 REGION:WESTERN

**** FEED BLEND ****

            CRUDE ORIGIN            LV %            BPCD

             CANDNL                 65.1            319982
             SYNCRUDE               31.5            154830
             CONDENSA               3.4             16711.8
              No.  MBP          LV %      S.G.       API          SULFUR WT%  BPCD        Lbs/hr FEED     Lbs/hr SULFUR
              Total             100                                           491523        6.0441E+06      18809.3
              Average                   .844146    36.1251       .311201

                **** MATERIAL BALANCE ****


             CRUDE UNIT
              No. Name           BPCD         Lbs/hr        IBP          EBP         S.G.          API           SULFUR WT%  Lbs/hr Su
                            *** FEED ***
             0   CRUDE FEED     491523       6.0441E+06    60           1240        .844146    36.125            .311201       18809.3
                            *** PRODUCT ***
             2   OVERHEAD       48946.9      453786        60           170.177     .636437    90.8316           .0147195      66.7949
             28  LSR            33569.9      329760        60           170.177     .674338    78.3354           .02026        66.8093
             3   NAPHTHA        85542.2      942505        170.177      321.699     .756368    55.5782           .0148716      140.166
             4   KEROSENE       127483       1.54691E+06   321.699      560         .832995    38.369            .0623346      964.26
             5   LGO            56069        719549        560          660         .880983    29.116            .219173       1577.06
             1   REDUCED CRUDE  173482       2.38135E+06   660          1240        .942321    18.6611           .67445        16061


             VACUUM UNIT
              No. Name           BPCD         Lbs/hr        IBP          EBP         S.G.          API           SULFUR WT%  Lbs/hr Su
                            *** FEED ***
             32  REDUCED CRUDE  173482       2.38135E+06   660          1240        .942321    18.6611           .67445        16061
                            *** PRODUCT ***
             6   HVGO           142030       1.90202E+06   660          1050        .919318    22.4184           .412657       7848.83
             7   RESIDUUM       31451.8      479330        1050         1240        1.04621    3.75011           1.7133        8212.36


             CAT CRACKER
              No. Name           BPCD         Lbs/hr        IBP          EBP         S.G.          API           SULFUR WT%  Lbs/hr Su
                            *** FEED ***
             65  LGO            4587.2       58868.8       560          660         .880983    29.116            .219173       129.025
             64  HVGO           136558       1.82874E+06   660          1050        .919318    22.4184           .412657       7546.44
                            *** TOTAL FEED ***
             8   FCCU FEED      141145       1.88761E+06   560          1050        .918072    22.6273           .406623       7675.47
                            *** PRODUCT ***
             12  LCO            22583.2      319867        430          650         .972331    14.0266           .702285       2246.38
             13  HCO            5645.8       88951.7       650          736.632     1.08158    -.672867          1.10961       987.017
             14  CRACKED GAS    79299.4      867180                                 .750705    56.9895           .0407357      353.252
             39  C3/C4 -FCCU    34986.4      286795                                 .564022    119.377           0             0
             *** PRODUCT ***
             < 18 > LE FROM CAT CRACKER (FOE)= 13124
             AVAILABLE C3/C4 OLEFINS= 34987.7
             CONVERSION Wt%= 78.342       CONVERSION Vol %= 80
             COKE, WT% 10.3926
             COKE  ,0/HR 196272           Sulfur in Flue Gas,Lbs/hr= 410.389
```

```
CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 15000





*** PRODUCT ***
< 15 > POLYMER= 6114.84
< 16 > LE FROM POLY (FOE)= 4713.3


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 28813.2
< 62 > C3/C4 TO ALKYL= 19906.4
< 20 > I-C4 FR. GAS PLANT= 7101.73
< 21 > I-C4 IMPORTED= 1805.06
*** PRODUCT ***
< 50 > ALKYLATE= 20557.9
< 63 > LE FROM ALKYL (FOE)= 2472.21


CATALYTIC REFORMER UNIT
 No. Name          BPCD        Lbs/hr        IBP        EBP        S.G.       API        SULFUR WT%  Lbs/hr Su
             *** FEED ***
 9   REFORMER FEED 71000       782279        170.177    321.699    .756368    55.5782       0           0
             *** PRODUCT ***
 17  REFORMATE     61311.1     721154                              .807456    43.7418       0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 6817.94
CONVERSION(LV%)= 86.3537    Severity (RON Clear)= 91.8  FEED KW= 11.8151


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 48946.9
< 57 > LE FROM REFORMER (FOE)= 6817.94
< 18 > LE FROM CAT CRACKER (FOE)= 13124
< 16 > LE FROM POLY (FOE)= 4713.3
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 20473
< 20 > I-C4 FR. GAS PLANT= 7101.73
< 49 > REF C4 TO BLENDING = 12073.6
< 69 > LSR= 30855.1


ISOMERIZATION UNIT (ONCE THRU)
*** FEED ***
< 69 > LSR= 30855.1
*** PRODUCT ***
< 29 > LSR+ISO= 30855.1


*** BY-PASS= 100 %   ***
```

```
GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 30855.1
< 26 > REFORMATE= 54329.1
< 50 > ALKYLATE= 20557.9
< 15 > POLYMER= 6114.84
< 14 > CRACKED GAS= 79299.4
< 49 > REF C4 TO BLENDING = 12073.6
< 68 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 60195
< 23 > UNLEADED REGULAR= 126555
< 24 > UNLEADED PREMIUM= 13901
< 25 > AVIATION GASOLINE= 2579


*** GASOLINE COMPOSITION ***


                LR            UR            UP            AV


LSR             .349322       .0776554      0             0
CRACKED GAS     .335308       .4            .611003       0
REFORMATE       .265497       .303011       0             0
POLYMER         0             .0483177      0             0
ALKYLATE        0             .106243       .33           .9786
C4              .0490737      .064773       .0589972      .0214


TURBO FUEL BLENDING
*** FEED ***
< 30 > LSR= 2714.79
< 58 > NAPHTHA= 14165.2
< 59 > KEROSENE= 21112
*** PRODUCT ***
< 42 > JET FUEL B= 20883
< 43 > JET FUEL A= 17109


*** TURBO FUEL COMPOSITION ***


                NAPHTHA BASE  KEROSENE BASE


LSR             .13           0
NAPHTHA         .58           .12
KEROSENE        .29           .88


DISTILLATE BLENDING
*** FEED ***
< 60 > KEROSENE= 106371
< 40 > LGO= 50172.5
< 38 > LCO= 20583.2
*** PRODUCT ***
< 44 > STOVE OIL= 5913
< 45 > LIGHT FUEL OIL= 13398
< 46 > DIESEL FUEL= 157816
```

```
*** DISTILLATE COMPOSITION ***


               STOVE OIL    DIESEL FUEL   LFO


KEROSENE          1            .63          .077194
LCO               0            .1           .358382
LGO               0            .27          .564424


HEAVY FUEL OIL BLENDING
*** FEED ***
< 41 > LGO= 1309.36
< 35 > LCO= 2000
< 13 > HCO= 5645.8
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 15386.8
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 24342




              OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 6982
< 36 > HVGO TO LUBE OIL= 5472
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 16065
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 377
< 67 > VGO PETROCHEMICAL FEED= 0

DISTILLATE DESULFURIZATION


        STREAM            TOTAL                 FEED  TO  DDS                                        FINAL STREAM
                           BPCD        BPCD       Lbs/hr     SULFUR WT%               % BYPASS       SULFUR WT%
        KEROSENE          127483      127483     1.54691E+06  .0623346                  0            3.11858E-03
        LGO               51481.8     51481.8    660680       .219173                   0            .0219606
        LCO               22583.2     11291.6    159934       .702295                   50           .387481
        HCO               5645.8      0          0            1.10961                   100          1.10961
        VAC RESIDUUM      15386.8     0          0            1.7133                    100          1.7133
```

PRODUCT SLATES & SPECIFICATIONS

	JE[illegible]	[illegible]			[illegible]	
BPCD	20083	1710[illegible]	[illegible]	[illegible]		
S.[illegible]	[illegible]		[illegible]995	.910016	.859885	1.03945
ASTM 10%	190.282	340.601	386.075	493.667	402.683	
AS[illegible]		366.328	400.455	532.463	428.149	
ASTM 50%	275.357	431.518	447.601	586.345	504.39	
ASTM 90%	470.816	516.876	519.582	624.189	607.383	
RVP,psia	2.56814					
Sulfur Wt %	.011789	4.41186E-03	3.11673E-03	.160103	.0516417	1.38851
Flash Point,F	59.6478	131.35	145.297	205.356	153.116	
Pour Point,F	-90.0086	-50.7191	-43.8634	-24.0942	-33.2096	
Cetane No.					42.4929	
Visc @100F,cs	.769360	1.60256	1.82995	4.7148	2.55367	1276.14
Visc @122F,cs	.670756	1.367	1.54957	3.7195	2.11671	477.972
Watsons K	11.7932	11.6415	11.6072	11.0979	11.4468	10.7858
MeABP	282.777	422.041	443.872	570.00	493.616	949.3

GASOLINE

LEADED REGULAR,BPCD	60195
TEL Addition,cc/IG: 1.24	
RON / MON / (R+M)/2 (Clear)	86.7600 / 79.1221 / 82.9415
RON / MON / (R+M)/2	92.1802 / 84.0629 / 88.1216
RVP,psia	10.5900

MMT Addition,mg/l: 0	
UNLEADED REGULAR,BPCD	126555
RON / MON / (R+M)/2	91.4 / 82.9313 / 87.1657
RVP,psia	9.96690

UNLEADED PREMIUM,BPCD	13901
RON / MON / (R+M)/2	93.7429 / 86.3273 / 90.0351
RVP,psia	9.80222

AVIATION GASOLINE,BPCD	2579
RON / MON / (R+M)/2	93 / 90.8 / 91.9
RVP,psia	10

```
                    STREAMS
            ____________________

< 0 > CRUDE FEED= 491523                     < 1 > REDUCED CRUDE= 173482
< 2 > OVERHEAD= 48946.9                      < 3 > NAPHTHA= 85542.2
< 4 > KEROSENE= 127483                       < 5 > LGO= 56069
< 6 > HVGO= 142030                           < 7 > RESIDUUM= 31451.8
< 8 > FCCU FEED= 141145                      < 9 > REFORMER FEED= 71000
< 10 > CAT POLY FEED= 15000                  < 11 > ALKYLATION FEED= 28813.2
< 12 > LCO= 22583.2                          < 13 > HCO= 5645.8
< 14 > CRACKED GAS= 79299.4                  < 15 > POLYMER= 6114.84
< 16 > LE FROM POLY (FOE)= 4713.3            < 17 > REFORMATE= 61311.1
< 18 > LE FROM CAT CRACKER (FOE)= 13124      < 19 > FUEL GAS (FOE)= 20473
< 20 > I-C4 FR. GAS PLANT= 7101.73           < 21 > I-C4 IMPORTED= 1005.06
< 22 > LEADED REGULAR= 60195                 < 23 > UNLEADED REGULAR= 126555
< 24 > UNLEADED PREMIUM= 13901               < 25 > AVIATION GASOLINE= 2579
< 26 > REFORMATE= 54329.1                    < 27 > NAPHTHA SPECIALTIES= 6982
< 28 > LSR= 33569.9                          < 29 > LSR+ISO= 30855.1
< 30 > LSR= 2714.79                          < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 173482                 < 33 > VAC RESID TO ASPHALT PLANT= 16065
< 34 > VAC RESIDUUM= 15386.8                 < 35 > LCO= 2000
< 36 > HVGO TO LUBE OIL= 5472                < 37 > HVGO= 0
< 38 > LCO= 20583.2                          < 39 > C3/C4 -FCCU= 34906.4
< 40 > LGO= 50172.5                          < 41 > LGO= 1309.36
< 42 > JET FUEL B= 20083                     < 43 > JET FUEL A= 17109
< 44 > STOVE OIL= 5913                       < 45 > LIGHT FUEL OIL= 13398
< 46 > DIESEL FUEL= 157816                   < 47 > HEAVY FUEL OIL= 24342
< 48 > RESID TO COKING= 0                    < 49 > REF C4 TO BLENDING = 12073.6
< 50 > ALKYLATE= 20557.9                     < 51 > CRUDE LIGHT ENDS= 3.12845
< 52 > TOTAL PRODUCT= 471587                 < 53 > C2 % IN CRUDE FEED= .10416
< 54 > C3 % IN CRUDE FEED= .87234            < 55 > I-C4 % IN CRUDE FEED= .41795
< 56 > N-C4 % IN CRUDE FEED= 1.734           < 57 > LE FROM REFORMER (FOE)= 6817.94
< 58 > NAPHTHA= 14165.2                      < 59 > KEROSENE= 21112
< 60 > KEROSENE= 106371                      < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 19906.4               < 63 > LE FROM ALKYL (FOE)= 2472.21
< 64 > HVGO= 136558                          < 65 > LGO = 4587.2
< 66 > NAPHTHA PETROCHEMICAL FEED= 377       < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                        < 69 > LSR= 30855.1
```

```
                              LIGHT ENDS BALANCE

                                 *** FROM ***



             CRUDE UNIT    REFORMER    CAT CRACKER   POLY       ALKYL       ISO        TOTAL
C2  ,#/HR     2684.77       3476.88     43033.7      0          0           0          49195.4
C3  ,#/HR     31729.4       13361.6     30613.5      13514.9    14664.4     0          103884
IC4  ,#/HR    16907.1       11633.5     71015        32980.3    0           0          132536
NC4  ,#/HR    72633.1       16977.9     27690.3      11898.7    15790.7     0          144991
H2  ,#/HR     0             12198.2     17613.4      0          0           0          29811.6
C1  ,#/HR     0             3476.88     17843.3      0          0           0          21320.2
H2S  ,#/HR    0             0           3908.33      0          0           0          3908.33
C2=  ,#/HR    0             0           26240.1      0          0           0          26240.1
C3=  ,#/HR    0             0           69593.2      0          0           0          69593.2
C4=  ,#/HR    0             0           108102       0          0           0          108102
TOTAL  ,#/HR  123954        61125       415653       58393.9    30455.1     0          689581
BPCD (FOE)    10031.5       6817.94     35923.6      4713.3     2472.21     0          59958.6


                                 *** TO ***
             POLY          ALKY        GAS BLEND     PC FEED    DDS         FUEL GAS   TOTAL
C2  ,#/HR     0             0           0            0          0           49195.4    49195.4
C3  ,#/HR     11050         14664.4     0            0          0           78169.5    103884
IC4  ,#/HR    30515.5       98944.1     2626.87      0          0           449.435    132536
NC4  ,#/HR    11898.7       15790.6     100168       0          0           17133.4    144991
H2  ,#/HR     0             0           0            0          15861.7     13949.9    29811.6
C1  ,#/HR     0             0           0            0          0           21320.2    21320.2
H2S  ,#/HR    0             0           0            0          0           3908.33    3908.33
C2=  ,#/HR    0             0           0            0          0           26240.1    26240.1
C3=  ,#/HR    23325.5       30955.2     0            0          0           15312.5    69593.2
C4=  ,#/HR    46451.9       61646.1     3.26232      0          0           0          108102
TOTAL  ,#/HR  123242        222000      102798       0          15861.7     225679     689581
BPCD (FOE)    9820          17726       8278.75      0          3660.89     20473      59958.6
```

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                         **** OVERALL MASS BALANCE ****
*** FEED ***


                         BPCD                        #/HR


CRUDE                     491523                      6.0441E+06
BUTANE                    1805.06                     14855.6
TOTAL                     493328                      6.05896E+06




*** PRODUCT ***


FUEL GAS (FOE)            20473                       225679
MOTOR GASOLINE            203230                      2.18335E+06
AVIATION TURBO FUELS      37992                       438918
DISTILLATES               177127                      2.22615E+06
HEAVY FUEL OIL            24342                       368578
OTHER PRODUCTS            28896                       404390
H2 TO DESULFURIZERS (FOE) 3660.09                     15861.7
COKE (FOE)                10453.4                     196272
TOTAL                     506174                      6.0592E+06
```

```
TIME:03.24.26 DATE:SATJUN161984168 65
REFINERY SIMULATION PROGRAM

CASE:WESBAS51 REGION:WESTERN

**** FEED BLEND ****

           CRUDE ORIGIN            LV %          BPCD

            CANDNL                 65.1          319780
            SYNCRUDE               31.5          154732
            CONDENSA               3.4           16701.3
              No.  MBP          LV %      S.G.        API          SULFUR WT%  BPCD         Lbs/hr FEED      Lbs/hr SULFUR
              Total             100                                            491214       6.04029E+06      18797.4
              Average                   .844146     36.1252       .311201

               **** MATERIAL BALANCE ****


            CRUDE UNIT
              No. Name          BPCD        Lbs/hr        IBP         EBP         S.G.        API           SULFUR WT%  Lbs/hr Su
                        *** FEED ***
             0   CRUDE FEED     491214      6.04029E+06   60          1240        .844145   36.1253         .3112       18797.4
                        *** PRODUCT ***
             2   OVERHEAD       48733.1     451588        60          169.803     .636133   90.9379         .0147219    66.4824
             28  LSR            33365.8     327633        60          169.803     .674087   78.4136         .0202913    66.481
             3   NAPHTHA        86251.1     950495        169.803     322.718     .756511   55.5429         .0148992    141.616
             4   KEROSENE       126823      1.53927E+06   322.718     560         .833195   38.3282         .0625231    962.399
             5   LGO            56033.7     719096        560         660         .880983   29.116          .219173     1576.06
             1   REDUCED CRUDE  173372      2.37984E+06   660         1240        .942321   18.6611         .67445      16050.8


            VACUUM UNIT
              No. Name          BPCD        Lbs/hr        IBP         EBP         S.G.        API           SULFUR WT%  Lbs/hr Su
                        *** FEED ***
             32  REDUCED CRUDE  173372      2.37984E+06   660         1240        .942321   18.6611         .67445      16050.8
                        *** PRODUCT ***
             6   HVGO           141941      1.90083E+06   660         1050        .919318   22.4184         .412657     7843.92
             7   RESIDUUM       31431.3     479017        1050        1240        1.04621   3.75011         1.7133      8207.01


            CAT CRACKER
              No. Name          BPCD        Lbs/hr        IBP         EBP         S.G.        API           SULFUR WT%  Lbs/hr Su
                        *** FEED ***
             65  LGO            3931.2      50450.2       560         660         .880983   29.116          .219173     110.573
             64  HVGO           136469      1.82755E+06   660         1050        .919318   22.4184         .412657     7541.52
                        *** TOTAL FEED ***
             8   FCCU FEED      140400      1.878E+06     560         1050        .918244   22.5985         .40746      7652.1
                        *** PRODUCT ***
             12  LCO            22464       318279        430         650         .972638   13.9886         .703695     2239.72
             13  HCO            5616.01     88496.3       650         736.64      1.00175   -.693436        1.11184     983.937
             14  CRACKED GAS    78834.7     862155                                .750754   56.9772         .0408496    352.187
             39  C3/C4 -FCCU    34711.7     285206                                .564044   119.367         0           0
            *** PRODUCT ***
            < 18 > LE FROM CAT CRACKER (FOE)= 13074.1
            AVAILABLE C3/C4 OLEFINS= 34711.7
            CONVERSION Wt%= 78.34        CONVERSION Vol %= 80
            COKE, WT% 10.422
            COKE  ,0/HR 195026           Sulfur in Flue Gas,Lbs/hr= 408.916
```

```
CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 15000
*** PRODUCT ***
< 15 > POLYMER= 6114.26
< 16 > LE FROM POLY (FOE)= 4714.16


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 28530.6
< 62 > C3/C4 TO ALKYL= 19711.7
< 20 > I-C4 FR. GAS PLANT= 7020.46
< 21 > I-C4 IMPORTED= 1798.4
*** PRODUCT ***
< 50 > ALKYLATE= 28354.4
< 63 > LE FROM ALKYL (FOE)= 2449.97


CATALYTIC REFORMER UNIT
  No. Name          BPCD        Lbs/hr        IBP        EBP         S.G.       API          SULFUR WT%  Lbs/hr Su
             *** FEED ***
 9   REFORMER FEED 71500        787937       169.803    322.718    .756511   55.5429          0            0
             *** PRODUCT ***
 17  REFORMATE     62159.6      733114                              .809643   43.2685          0            0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 6035.57
CONVERSION(LV%)= 86.9365    Severity (RON Clear)= 90.5  FEED KW= 11.8145


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 48733.1
< 57 > LE FROM REFORMER (FOE)= 6035.57
< 18 > LE FROM CAT CRACKER (FOE)= 13074.1
< 16 > LE FROM POLY (FOE)= 4714.16
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 19636
< 20 > I-C4 FR. GAS PLANT= 7020.46
< 49 > REF C4 TO BLENDING = 12098.1
< 69 > LSR= 30651


ISOMERIZATION UNIT (ONCE THRU)
*** FEED ***
< 69 > LSR= 30651
*** PRODUCT ***
< 29 > LSR+ISO= 30651


*** BY-PASS= 100 %   ***
```

```
          GASOLINE BLENDING
          *** FEED ***
          < 29 > LSR+ISO= 38651
          < 26 > REFORMATE= 55177.6
          < 50 > ALKYLATE= 20354.4
          < 15 > POLYMER= 6114.26
          < 14 > CRACKED GAS= 78834.7
          < 49 > REF C4 TO BLENDING = 12098.1
          < 68 > IMPORTED C4= 0
          *** PRODUCT ***
          < 22 > LEADED REGULAR= 20865
          < 23 > UNLEADED REGULAR= 166685
          < 24 > UNLEADED PREMIUM= 13901
          < 25 > AVIATION GASOLINE= 2579


          *** GASOLINE COMPOSITION ***


                   LR            UR            UP            AV


LSR             .395272       .136304       0             0
CRACKED GAS     .343843       .37           .738224       0
REFORMATE       .214399       .301684       .0424044      0
POLYMER         0             .0366815      0             0
ALKYLATE        0             .0944551      .15           .9786
C4              .0464858      .0608749      .0693716      .0214


         TURBO FUEL BLENDING
         *** FEED ***
         < 30 > LSR= 2714.79
         < 58 > NAPHTHA= 14374
         < 59 > KEROSENE= 20903.2
         *** PRODUCT ***
         < 42 > JET FUEL B= 20883
         < 43 > JET FUEL A= 17109


         *** TURBO FUEL COMPOSITION ***


                       NAPHTHA BASE  KEROSENE BASE


         LSR            .13           0
         NAPHTHA        .59           .12
         KEROSENE       .28           .88


         DISTILLATE BLENDING
         *** FEED ***
         < 60 > KEROSENE= 105920
         < 40 > LGO= 52013.8
         < 38 > LCO= 19193
         *** PRODUCT ***
         < 44 > STOVE OIL= 5913
         < 45 > LIGHT FUEL OIL= 13398
         < 46 > DIESEL FUEL= 157816
```

```
*** DISTILLATE COMPOSITION ***


                STOVE OIL     DIESEL FUEL   LFO


KEROSENE        1             .63           .0435172









LCO             0             .1            .254623
LGO             0             .27           .701859

HEAVY FUEL OIL BLENDING
*** FEED ***
< 41 > LGO= 88.6919
< 35 > LCO= 3271
< 13 > HCO= 5616.01
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 15366.3
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 24342


                OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 6982
< 36 > HVGO TO LUBE OIL= 5472
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 16065
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 377
< 67 > VGO PETROCHEMICAL FEED= 0

DISTILLATE DESULFURIZATION


      STREAM              TOTAL                   FEED  TO  DDS                                    FINAL STREAM
                           BPCD        BPCD       Lbs/hr      SULFUR WT%             % BYPASS     SULFUR WT%
      KEROSENE            126823      126823     1.53927E+06  .0625231                0           3.12801E-03
      LGO                 52102.5     52102.5    668646       .219173                 0           .0219606
      LCO                 22464       11232      159140       .703695                 50          .388262
      HCO                 5616.01     0          0            1.11184                 100         1.11184
      VAC RESIDUUM        15366.3     0          0            1.7133                  100         1.7133
```

PRODUCT SLATES & SPECIFICATIONS

	JET FUEL B	JET FUEL A	STOVE OIL	LFO	DIESEL FUEL	HFO
BPCD	20883	17109	5913	13398	157816	24342
S.G.	.767268	.823993	.833195	.902241	.860042	1.04392
ASTM 10%	197.859	341.335	387.02	520.72	401.651	
ASTM 20%	219.075	367.131	401.304	550.849	428.897	
ASTM 50%	274.292	432.127	448.234	594.304	504.312	
ASTM 90%	468.448	516.97	519.682	627.167	607.37	
RVP,psia	2.57771					
Sulfur Wt %	.0119354	4.42322E-03	3.12616E-03	.121383	.0517399	1.39825
Flash Point,F	59.4154	131.761	145.802	220.356	153.638	
Pour Point,F	-98.162	-50.4982	-43.6443	-9.78706	-33.0732	
Cetane No.					42.4664	
Visc @100F,cs	.765478	1.60797	1.83648	5.06586	2.56075	1222.61
Visc @122F,cs	.675467	1.37137	1.55479	3.98968	2.1222	456.7
Watsons K	11.7977	11.6412	11.6069	11.2363	11.4463	10.7279
MeABP	281.719	422.615	444.453	581.94	494.018	944.65

GASOLINE

LEADED REGULAR,BPCD	20865
TEL Addition,cc/IG: 1.24	
RON / MON / (R+M)/2 (Clear)	85.6094 / 78.3248 / 81.9671
RON / MON / (R+M)/2	91.1917 / 83.4319 / 87.3118
RVP,psia	10.7361
MMT Addition,mg/l: 18	
UNLEADED REGULAR,BPCD	166685
RON / MON / (R+M)/2	91.4 / 82.5566 / 86.9783
RVP,psia	10.1114
UNLEADED PREMIUM,BPCD	13901
RON / MON / (R+M)/2	94.7999 / 85.2726 / 90.0363
RVP,psia	9.79575
AVIATION GASOLINE,BPCD	2579
RON / MON / (R+M)/2	93 / 90.8 / 91.9
RVP,psia	10

STREAMS

```
< 0 > CRUDE FEED= 491214                      < 1 > REDUCED CRUDE= 173372
< 2 > OVERHEAD= 48733.1                       < 3 > NAPHTHA= 86251.1
< 4 > KEROSENE= 126823                        < 5 > LGO= 56033.7
< 6 > HVGO= 141941                            < 7 > RESIDUUM= 31431.3
< 8 > FCCU FEED= 140400                       < 9 > REFORMER FEED= 71500
< 10 > CAT POLY FEED= 15000                   < 11 > ALKYLATION FEED= 28530.6
< 12 > LCO= 22464                             < 13 > HCO= 5616.01
< 14 > CRACKED GAS= 78834.7                   < 15 > POLYMER= 6114.26
< 16 > LE FROM POLY (FOE)= 4714.16            < 17 > REFORMATE= 62159.6
< 18 > LE FROM CAT CRACKER (FOE)= 13074.1     < 19 > FUEL GAS (FOE)= 19636
< 20 > I-C4 FR. GAS PLANT= 7020.46            < 21 > I-C4 IMPORTED= 1798.4
< 22 > LEADED REGULAR= 20065                  < 23 > UNLEADED REGULAR= 166685
< 24 > UNLEADED PREMIUM= 13901                < 25 > AVIATION GASOLINE= 2579
< 26 > REFORMATE= 55177.6                     < 27 > NAPHTHA SPECIALTIES= 6982
< 28 > LSR= 33365.8                           < 29 > LSR+ISO= 30651
< 30 > LSR= 2714.79                           < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 173372                  < 33 > VAC RESID TO ASPHALT PLANT= 16065
< 34 > VAC RESIDUUM= 15366.3                  < 35 > LCO= 3271
< 36 > HVGO TO LUBE OIL= 5472                 < 37 > HVGO= 0
< 38 > LCO= 19193                             < 39 > C3/C4 -FCCU= 34711.7
< 40 > LGO= 52013.8                           < 41 > LGO= 88.6919
< 42 > JET FUEL B= 20883                      < 43 > JET FUEL A= 17109
< 44 > STOVE OIL= 5913                        < 45 > LIGHT FUEL OIL= 13398
< 46 > DIESEL FUEL= 157816                    < 47 > HEAVY FUEL OIL= 24342
< 48 > RESID TO COKING= 0                     < 49 > REF C4 TO BLENDING = 12098.1
< 50 > ALKYLATE= 20354.4                      < 51 > CRUDE LIGHT ENDS= 3.12045
< 52 > TOTAL PRODUCT= 471587                  < 53 > C2 % IN CRUDE FEED= .10416
< 54 > C3 % IN CRUDE FEED= .87234             < 55 > I-C4 % IN CRUDE FEED= .41795
< 56 > N-C4 % IN CRUDE FEED= 1.734            < 57 > LE FROM REFORMER (FOE)= 6035.57
< 58 > NAPHTHA= 14374                         < 59 > KEROSENE= 20903.2
< 60 > KEROSENE= 105920                       < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 19711.7                < 63 > LE FROM ALKYL (FOE)= 2449.97
< 64 > HVGO= 136469                           < 65 > LGO = 3931.2



< 66 > NAPHTHA PETROCHEMICAL FEED= 377        < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                         < 69 > LSR= 30651
```

```
                          LIGHT ENDS BALANCE


                            *** FROM ***
              CRUDE UNIT   REFORMER     CAT CRACKER  POLY        ALKYL       ISO         TOTAL
C2   ,#/HR    2683.08      2725.42      42890.3      0           0           0           48298.8
C3   ,#/HR    31709.4      11992.3      30452        13518.7     14525.9     0           102198
IC4  ,#/HR    16896.4      10950.3      70598.5      32972.7     0           0           131418
NC4  ,#/HR    72587.4      15980.8      27568.4      11913.2     15655.3     0           143705
H2   ,#/HR    0            10448.3      17554.6      0           0           0           28002.9
C1   ,#/HR    0            2725.42      17783.8      0           0           0           20509.2
H2S  ,#/HR    0            0            3896.55      0           0           0           3896.55
C2=  ,#/HR    0            0            26152.6      0           0           0           26152.6
C3=  ,#/HR    0            0            69104.9      0           0           0           69104.9
C4=  ,#/HR    0            0            107558       0           0           0           107558
TOTAL  ,#/HR  123876       54822.5      413560       58404.6     30181.2     0           680844
BPCD (FOE)    10025.2      6035.58      35747.3      4714.17     2449.97     0           58972.2


                            *** TO ***
              POLY         ALKY         GAS BLEND    PC FEED     DDS         FUEL GAS    TOTAL
C2   ,#/HR    0            0            0            0           0           48298.8     48298.8
C3   ,#/HR    11053.8      14525.9      0            0           0           76618.6     102198
IC4  ,#/HR    30507.8      97869.1      2628.34      0           0           412.676     131418
NC4  ,#/HR    11913.2      15655.2      100378       0           0           15758.7     143705
H2   ,#/HR    0            0            0            0           15922.9     12080.1     28002.9
C1   ,#/HR    0            0            0            0           0           20509.2     20509.2
H2S  ,#/HR    0            0            0            0           0           3896.55     3896.55
C2=  ,#/HR    0            0            0            0           0           26152.6     26152.6
C3=  ,#/HR    23292.6      30609.2      0            0           0           15203.1     69104.9
C4=  ,#/HR    46479.1      61078.9      0            0           0           0           107558
TOTAL  ,#/HR  123247       219738       103006       0           15922.9     218930      680844
BPCD (FOE)    9820.39      17545.3      8295.53      0           3674.99     19636       58972.2
```

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                          **** OVERALL MASS BALANCE ****.
*** FEED ***


                          BPCD                      #/HR


CRUDE                      491214                    6.04029E+06
BUTANE                     1798.4                    14800.8
TOTAL                      493012                    6.05509E+06





*** PRODUCT ***


FUEL GAS (FOE)            19636                     218930
MOTOR GASOLINE            203230                    2.1861E+06
AVIATION TURBO FUELS      37992                     438766
DISTILLATES               177127                    2.22501E+06
HEAVY FUEL OIL            24342                     370164
OTHER PRODUCTS            28896                     404613
H2 TO DESULFURIZERS (FOE) 3674.99                   15922.9
COKE (FOE)                10429.7                   195826
TOTAL                     505328                    6.05534E+06
```

"D"

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TIME:05.13.01 DATE:SATJUN161984168 65
REFINERY SIMULATION PROGRAM

CASE:ATLBAS20 REGION:ATLANTIC

**** FEED BLEND ****

            CRUDE ORIGIN              LV %            BPCD

             FRONTIER                 33              44998.7
             VENEZL                   7               9545.19
             ARABL                    30.6            41726.1
             SYNCRUDE                 15              20454
             MEXL                     9.9             13499.6
             NORTHSEA                 4.5             6136.19
               No.  MBP         LV %        S.G.        API          SULFUR WT%  BPCD          Lbs/hr FEED     Lbs/hr SULFUR
               Total            100                                              136360        1.72267E+06     20719.8
               Average                      .867354     31.6399      1.20263

                **** MATERIAL BALANCE ****


             CRUDE UNIT
               No. Name          BPCD        Lbs/hr       IBP         EBP         S.G.       API          SULFUR WT%  Lbs/hr Su
                          *** FEED ***
               0   CRUDE FEED    136360      1.72287E+06  60          1360        .867352    31.6402      1.20263     20719.8
                          *** PRODUCT ***
               2   OVERHEAD      8690.18     81169.8      60          170.07      .641203    89.179       .014548     11.8086
               28  LSR           6496.63     63160.1      60          170.07      .667398    80.5174      .0187824    11.863
               3   NAPHTHA       11513.6     121817       170.07      271.927     .726316    63.3188      .0227447    27.7068
               4   KEROSENE      37104       436456       271.927     540         .807514    43.7292      .17025      743.067
               5   LGO           17020.2     215835       540         660         .870536    31.0435      .767538     1656.61
               1   REDUCED CRUDE 62031.9     867592       660         1360        .960131    15.9757      2.10705     18280.6


             VACUUM UNIT
               No. Name          BPCD        Lbs/hr       IBP         EBP         S.G.       API          SULFUR WT%  Lbs/hr Su
                          *** FEED ***
               32  REDUCED CRUDE 62031.9     867592       660         1360        .960131    15.8757      2.10705     18280.6
                          *** PRODUCT ***
               6   HVGO          43928       589112       660         1050        .920633    22.1986      1.3757      8104.42
               7   RESIDUUM      18103.9     278475       1050        1360        1.05595    2.50256      3.65395     10175.3


             CAT CRACKER
               No. Name          BPCD        Lbs/hr       IBP         EBP         S.G.       API          SULFUR WT%  Lbs/hr Su
                          *** FEED ***
               65  LGO           0           0            540         660         .870536    31.0435      .767538     0
               64  HVGO          43865       588267       660         1050        .920633    22.1986      1.3757      8092.79
                          *** TOTAL FEED ***
               8   FCCU FEED     43865       588267       540         1050        .920633    22.1986      1.3757      8092.79
                          *** PRODUCT ***
               12  LCO           10274.9     144503       430         650         .965448    15.0641      1.82902     2642.99
               13  HCO           2568.73     39562.4      650         775.158     1.05729    2.33272      2.88985     1143.29
               14  CRACKED GAS   22519.1     245389                               .748055    57.6572      .170157     417.545
               39  C3/C4 -FCCU   9158.12     75260.9                              .564148    119.321      0           0
             *** PRODUCT ***
             < 18 > LE FROM CAT CRACKER (FOE)= 2909.24
             AVAILABLE C3/C4 OLEFINS= 9159.16
             CONVERSION Wt%= 68.7106     CONVERSION Vol %= 70.72
             COKE, WT% 8.85746
             COKE  ,0/HR 52132.4          Sulfur in Flue Gas,Lbs/hr= 356.159
```

```
CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 9150.12
*** PRODUCT ***
< 15 > POLYMER= 3735.56
< 16 > LE FROM POLY (FOE)= 2877.02


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 0
< 62 > C3/C4 TO ALKYL= 0
< 20 > I-C4 FR. GAS PLANT= 0
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 0
< 63 > LE FROM ALKYL (FOE)= 0


CATALYTIC REFORMER UNIT
 No. Name          BPCD        Lbs/hr       IBP        EBP         S.G.      API          SULFUR WT%  Lbs/hr Su
             *** FEED ***
 9   REFORMER FEED 8000        93952.6      170.07     271.927    .726316   63.3188       0           0
             *** PRODUCT ***
 17  REFORMATE     6701        77023.5                            .789066   47.8259       0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 1993.24
CONVERSION(LV%)= 75.4617    Severity (RON Clear)= 98    FEED KW= 12.1715


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 8690.18
< 57 > LE FROM REFORMER (FOE)= 1993.24
< 18 > LE FROM CAT CRACKER (FOE)= 2909.24
< 16 > LE FROM POLY (FOE)= 2877.02
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 6169.02
< 20 > I-C4 FR. GAS PLANT= 0
< 49 > REF C4 TO BLENDING = 2771.07
< 69 > LSR= 6302.92


ISOMERIZATION UNIT (TOTAL RECYCLE)
*** FEED ***
< 69 > LSR= 6302.92
*** PRODUCT ***
< 29 > LSR+ISO= 6227.29


*** BY-PASS= 25 %   ***
```

```
      GASOLINE BLENDING
      *** FEED ***
      < 29 > LSR+ISO= 6227.29
      < 26 > REFORMATE= 6701
      < 50 > ALKYLATE= 0
      < 15 > POLYMER= 3735.56
      < 14 > CRACKED GAS= 22519.1
      < 49 > REF C4 TO BLENDING = 2771.07
      < 60 > IMPORTED C4= 0
      *** PRODUCT ***
      < 22 > LEADED REGULAR= 12500

      < 23 > UNLEADED REGULAR= 26410
      < 24 > UNLEADED PREMIUM= 2956
      < 25 > AVIATION GASOLINE= 0


      *** GASOLINE COMPOSITION ***


               LR          UR          UP          AV


LSR          .387351     .0512686    0           0
CRACKED GAS  .564654     .563        .183493     0
REFORMATE    0           .170713     .74124      0
POLYMER      0           .141402     0           0
ALKYLATE     0           0           0           .9786
C4           .0479956    .0736166    .0752666    .0214


      TURBO FUEL BLENDING
      *** FEED ***
      < 30 > LSR= 193.71
      < 58 > NAPHTHA= 1285.58
      < 59 > KEROSENE= 4684.71
      *** PRODUCT ***
      < 42 > JET FUEL B= 1761
      < 43 > JET FUEL A= 4403


      *** TURBO FUEL COMPOSITION ***


                NAPHTHA BASE  KEROSENE BASE


      LSR          .11           0
      NAPHTHA      .48           .1
      KEROSENE     .41           .9


      DISTILLATE BLENDING
      *** FEED ***
      < 60 > KEROSENE= 32419.2
      < 40 > LGO= 17010.8
      < 38 > LCO= 7557.94
      *** PRODUCT ***
      < 44 > STOVE OIL= 2390
      < 45 > LIGHT FUEL OIL= 26607
      < 46 > DIESEL FUEL= 27991
```

```
*** DISTILLATE COMPOSITION ***


                STOVE OIL     DIESEL FUEL   LFO


KEROSENE         1              .607          .490048
LCO              0              .139          .137828
LGO              0              .254          .372124

HEAVY FUEL OIL BLENDING
*** FEED ***
< 41 > LGO= 9.33228
< 35 > LCO= 2717
< 13 > HCO= 2568.73
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 8605.93





*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 13901


              OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 0
< 36 > HVGO TO LUBE OIL= 63
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 9498
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 1348
< 67 > VGO PETROCHEMICAL FEED= 0

DISTILLATE DESULFURIZATION


      STREAM             TOTAL                FEED  TO  DDS                                   FINAL STREAM
                         BPCD        BPCD       Lbs/hr    SULFUR WT%               % BYPASS    SULFUR WT%
      KEROSENE           37104       37104      436456     .17025                  0           8.52629E-03
      LGO                17020.2     17020.2    215835     .767538                 0           .0772877
      LCO                10274.9     7192.46    101152     1.82902                 29.9997     .684621
      HCO                2568.73     0          0          2.88985                 100         2.88985
      VAC RESIDUUM       8605.93     0          0          3.65395                 100         3.65395
```

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***PRODUCT SLATES & SPECIFICATIONS***


                 JET FUEL B   JET FUEL A    STOVE OIL     LFO          DIESEL FUEL   HFO

BPCD             1761         4403          2390          26607        27991         13901
S.G.             .753126      .799394       .807514       .852734      .845474       1.03839
ASTM 10%         205.831      311.57        344.717       369.648      361.788
ASTM 20%         221.21       335.19        362.264       410.536      393.468
ASTM 50%         261.828      398.203       411.836       518.100      483.256
ASTM 90%         470.111      494.495       496.868       610.451      603.403
RVP,psia         2.73982
Sulfur Wt %      .0161019     9.8056E-03    8.51249E-03   .138711      .132423       2.96714
Flash Point,F    64.0145      115.134       126.392       139.887      135.813
Pour Point,F     -80.9974     -50.3793      -45.4064      -29.4067     -37.1906
Cetane No.                                                             44.8877
Visc @100F,cs    .782465      1.33262       1.47432       2.47014      2.1599        1250.89
Visc @122F,cs    .69065       1.14938       1.26513       2.06062      1.81076       471.07
Watsons K        12.0528      11.8586       11.8202       11.53        11.5432       10.7963
MeABP            287.948      391.894       409.623       490.463      469.573       949.05


GASOLINE


          LEADED REGULAR,BPCD            12580
          TEL Addition,cc/IG: 1.24
          RON / MON / (R+M)/2 (Clear)    89.595 / 82.0098 / 85.8024
          RON / MON / (R+M)/2            93.9807 / 85.6232 / 89.802
          RVP,psia                       11.3923


          MMT Addition,mg/l: 0
          UNLEADED REGULAR,BPCD          26418
          RON / MON / (R+M)/2            94.1342 / 83.8664 / 89.0003
          RVP,psia                       10.0551


          UNLEADED PREMIUM,BPCD          2956

          RON / MON / (R+M)/2            96.82 / 86.7888 / 91.8044
          RVP,psia                       9.86766


          AVIATION GASOLINE,BPCD         0
          RON / MON / (R+M)/2            93 / 90.8 / 91.9
          RVP,psia                       10
```

STREAMS

```
< 0 > CRUDE FEED= 136360                        < 1 > REDUCED CRUDE= 62031.9
< 2 > OVERHEAD= 8690.18                         < 3 > NAPHTHA= 11513.6
< 4 > KEROSENE= 37104                           < 5 > LGO= 17020.2
< 6 > HVGO= 43928                               < 7 > RESIDUUM= 18103.9
< 8 > FCCU FEED= 43865                          < 9 > REFORMER FEED= 8800
< 10 > CAT POLY FEED= 9158.12                   < 11 > ALKYLATION FEED= 0
< 12 > LCO= 10274.9                             < 13 > HCO= 2568.73
< 14 > CRACKED GAS= 22519.1                     < 15 > POLYMER= 3735.56
< 16 > LE FROM POLY (FOE)= 2877.02              < 17 > REFORMATE= 6701
< 18 > LE FROM CAT CRACKER (FOE)= 2909.24       < 19 > FUEL GAS (FOE)= 6169.02
< 20 > I-C4 FR. GAS PLANT= 0                    < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 12580                    < 23 > UNLEADED REGULAR= 26418
< 24 > UNLEADED PREMIUM= 2956                   < 25 > AVIATION GASOLINE= 0
< 26 > REFORMATE= 6701                          < 27 > NAPHTHA SPECIALTIES= 0
< 28 > LSR= 6496.63                             < 29 > LSR+ISO= 6227.29
< 30 > LSR= 193.71                              < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 62031.9                   < 33 > VAC RESID TO ASPHALT PLANT= 9498
< 34 > VAC RESIDUUM= 8605.93                    < 35 > LCO= 2717
< 36 > HVGO TO LUBE OIL= 63                     < 37 > HVGO= 0
< 38 > LCO= 7557.94                             < 39 > C3/C4 -FCCU= 9158.12
< 40 > LGO= 17010.8                             < 41 > LGO= 9.33228
< 42 > JET FUEL B= 1761                         < 43 > JET FUEL A= 4403
< 44 > STOVE OIL= 2390                          < 45 > LIGHT FUEL OIL= 26607
< 46 > DIESEL FUEL= 27991                       < 47 > HEAVY FUEL OIL= 13901
< 48 > RESID TO COKING= 0                       < 49 > REF C4 TO BLENDING = 2771.07
< 50 > ALKYLATE= 0                              < 51 > CRUDE LIGHT ENDS= 1.60865
< 52 > TOTAL PRODUCT= 129916                    < 53 > C2 % IN CRUDE FEED= .02451
< 54 > C3 % IN CRUDE FEED= .31962               < 55 > I-C4 % IN CRUDE FEED= .19662
< 56 > N-C4 % IN CRUDE FEED= 1.0679             < 57 > LE FROM REFORMER (FOE)= 1993.24
< 58 > NAPHTHA= 1285.58                         < 59 > KEROSENE= 4684.71
< 60 > KEROSENE= 32419.2                        < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 0                        < 63 > LE FROM ALKYL (FOE)= 0
< 64 > HVGO= 43865                              < 65 > LGO = 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 1348         < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                           < 69 > LSR= 6302.92
```

```
                                   LIGHT ENDS BALANCE


                                      *** FROM ***
                   CRUDE UNIT      REFORMER        CAT CRACKER     POLY            ALKYL           ISO             TOTAL
C2    ,#/HR        175.264         1617.86         9295.23         0               0               0               11088.4
C3    ,#/HR        3225.17         4106.89         7908.5          8147.6          0               174.906         23563.1
IC4   ,#/HR        2206.55         2266.29         10526.4         20029.5         0               311.238         43340
NC4   ,#/HR        12409.6         3307.41         7468.96         7468.11         0               886.254         31540.3
H2    ,#/HR        0               4012.8          3633.32         0               0               0               7646.12
C1    ,#/HR        0               1617.86         3854.12         0               0               0               5471.98
H2S   ,#/HR        0               0               3753.61         0               0               0               3753.61
C2=   ,#/HR        0               0               5667.83         0               0               0               5667.83
C3=   ,#/HR        0               0               18290           0               0               0               18290
C4=   ,#/HR        0               0               28364.7         0               0               0               28364.7
TOTAL   ,#/HR      18016.6         16929.1         106763          35645.2         0               1372.4          178726
BPCD (FOE)         1455.47         1993.24         8855.13         2877.01         0               110.692         15291.5


                                      *** TO ***
                   POLY            ALKY            GAS BLEND       PC FEED         DDS             FUEL GAS        TOTAL
C2    ,#/HR        0               0               0               0               0               11088.4         11088.4
C3    ,#/HR        6642.39         0               0               0               0               16920.7         23563.1
IC4   ,#/HR        18524.3         0               11774.3         0               0               13041.4         43340
NC4   ,#/HR        7468.11         0               11421.5         0               0               12650.7         31540.3
H2    ,#/HR        0               0               0               0               5460.11         2186.01         7646.12
C1    ,#/HR        0               0               0               0               0               5471.98         5471.98
H2S   ,#/HR        0               0               0               0               0               3753.61         3753.61
C2=   ,#/HR        0               0               0               0               0               5667.83         5667.83
C3=   ,#/HR        14264.6         0               0               0               0               4025.42         18290
C4=   ,#/HR        28361.5         0               1.53554         0               0               1.68516         28364.7
TOTAL   ,#/HR      75260.9         0               23197.3         0               5460.11         74807.7         178726
BPCD (FOE)         5996.73         0               1865.6          0               1260.19         6169.02         15291.5
```

```
                        **** OVERALL MASS BALANCE ****
*** FEED ***


                        BPCD                      #/HR


CRUDE                    136360                    1.72287E+06
BUTANE                  0                         0
TOTAL                   136360                    1.72287E+06




*** PRODUCT ***


FUEL GAS (FOE)          6169.02                   74807.7
MOTOR GASOLINE          41954                     445130
AVIATION TURBO FUELS    6164                      70591.5
DISTILLATES             56988                     703358
HEAVY FUEL OIL          13901                     210270
OTHER PRODUCTS          10909                     161206
H2 TO DESULFURIZERS (FOE)  1260.19                5460.11
COKE (FOE)              2776.57                   52132.4
TOTAL                   140122                    1.72295E+06
```

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TIME:06.06.43 DATE:MONJUN111984163 60
REFINERY SIMULATION PROGRAM

CASE:ATLBAS21 REGION:ATLANTIC

#### FEED BLEND ####

            CRUDE ORIGIN             LV %            BPCD

             FRONTIER               33              44991.5
             VENEZL                 7               9543.66
             ARABL                  30.6            41719.4
             SYNCRUDE               15              20450.7
             MEXL                   9.9             13497.5
             NORTHSEA               4.5             6135.21
              No.  MBP          LV %       S.G.        API          SULFUR WT%  BPCD         Lbs/hr FEED      Lbs/hr SULFUR
              Total             100                                             136338        1.7226E+06       20716.5
              Average                    .867354     31.6399       1.20263

                #### MATERIAL BALANCE ####


             CRUDE UNIT
              No. Name           BPCD        Lbs/hr       IBP          EBP          S.G.        API            SULFUR WT%  Lbs/hr Su
                          ### FEED ###
              0   CRUDE FEED    136338       1.7226E+06   60           1360         .867356     31.6395        1.20263      20716.5
                          ### PRODUCT ###
              2   OVERHEAD      8664.22      80912.5      60           169.804      .641086     89.2193        .0145532     11.7754
              28  LSR           6471.02      62900        60           169.804      .667279     80.5553        .0187799     11.8125
              3   NAPHTHA       11533.6      122018       169.804      271.906      .726253     63.3357        .022736      27.742
              4   KEROSENE      37100.8      436417       271.906      540          .80751      43.73          .17024       742.956
              5   LGO           17017.4      215799       540          660          .870536     31.0435        .767538      1656.34
              1   REDUCED CRUDE 62022        867454       660          1360         .960131     15.8757        2.10705      10277.7


             VACUUM UNIT
              No. Name           BPCD        Lbs/hr       IBP          EBP          S.G.        API            SULFUR WT%  Lbs/hr Su
                          ### FEED ###
              32  REDUCED CRUDE 62022        867454       660          1360         .960131     15.8757        2.10705      10277.7
                          ### PRODUCT ###
              6   HVGO          43918        588978       660          1050         .920633     22.1986        1.3757       8102.57
              7   RESIDUUM      18104        278476       1050         1360         1.05595     2.50256        3.65395      10175.4


             CAT CRACKER
              No. Name           BPCD        Lbs/hr       IBP          EBP          S.G.        API            SULFUR WT%  Lbs/hr Su
                          ### FEED ###
              65  LGO           0            0            540          660          .870536     31.0435        .767538      0
              64  HVGO          43855        588133       660          1050         .920633     22.1986        1.3757       8090.95
                          ### TOTAL FEED ###
              8   FCCU FEED     43855        588133       540          1050         .920633     22.1986        1.3757       8090.95
                          ### PRODUCT ###
              12  LCO           10279.6      144565       430          650          .965424     15.0677        1.82822      2642.97
              13  HCO           2569.9       39578.2      650          775.239      1.05723     2.34032        2.88859      1143.25
              14  CRACKED GAS   22509.7      245206                                 .740055     57.6572        .170228      417.547
              39  C3/C4 -FCCU   9150.84      75201                                  .564148     119.321        0            0
             ### PRODUCT ###
             < 18 > LE FROM CAT CRACKER (FOE)= 2907.72
             AVAILABLE C3/C4 OLEFINS= 9153.55
             CONVERSION Wt%= 68.6902     CONVERSION Vol %= 70.7
             COKE, WT% 8.8531
             COKE  ,0/HR 52094.8         Sulfur in Flue Gas,Lbs/hr= 355.92
```

```
CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 9150.04
*** PRODUCT ***
< 15 > POLYMER= 3732.61
< 16 > LE FROM POLY (FOE)= 2874.71


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 0
< 62 > C3/C4 TO ALKYL= 0
< 20 > I-C4 FR. GAS PLANT= 0
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 0
< 63 > LE FROM ALKYL (FOE)= 0


CATALYTIC REFORMER UNIT
  No. Name          BPCD        Lbs/hr        IBP         EBP         S.G.        API         SULFUR WT%  Lbs/hr Su
              *** FEED ***
 9   REFORMER FEED 8900         94156         169.004     271.906     .726253     63.3357     0           0
              *** PRODUCT ***
 17  REFORMATE     6715.87      77188.1                               .789882     47.8405     0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 1997.8
CONVERSION(LV%)= 75.4392    Severity (RON Clear)= 98    FEED KW= 12.1718


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 8664.22
< 57 > LE FROM REFORMER (FOE)= 1997.8
< 18 > LE FROM CAT CRACKER (FOE)= 2907.72
< 16 > LE FROM POLY (FOE)= 2874.71
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 6136.01
< 20 > I-C4 FR. GAS PLANT= 0
< 49 > REF C4 TO BLENDING = 2771.22
< 69 > LSR= 6277.31


ISOMERIZATION UNIT (TOTAL RECYCLE)
*** FEED ***
< 69 > LSR= 6277.31
*** PRODUCT ***
< 29 > LSR+ISO= 6224.58


*** BY-PASS= 47.5 %   ***


GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 6224.58
< 26 > REFORMATE= 6715.87
< 50 > ALKYLATE= 0
< 15 > POLYMER= 3732.61
< 14 > CRACKED GAS= 22509.7
< 49 > REF C4 TO BLENDING = 2771.22
< 60 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 4915
< 23 > UNLEADED REGULAR= 34083
< 24 > UNLEADED PREMIUM= 2956
< 25 > AVIATION GASOLINE= 0


### GASOLINE COMPOSITION ###


              LR          UR          UP          AV


LSR           .428988     .128767     0           0
CRACKED GAS   .181365     .603        .360708     0
REFORMATE     .34635      .0982451    .563287     0
POLYMER       0           .109515     0           0
ALKYLATE      0           0           0           .9786
C4            .0432972    .0604725    .0760044    .0214


TURBO FUEL BLENDING
### FEED ###
< 30 > LSR= 193.71
< 58 > NAPHTHA= 1285.58
< 59 > KEROSENE= 4684.71
### PRODUCT ###
< 42 > JET FUEL B= 1761
< 43 > JET FUEL A= 4403


### TURBO FUEL COMPOSITION ###


               NAPHTHA BASE  KEROSENE BASE


LSR            .11           0
NAPHTHA        .48           .1
KEROSENE       .41           .9


DISTILLATE BLENDING
### FEED ###
< 60 > KEROSENE= 32416.1
< 40 > LGO= 17011.4
< 38 > LCO= 7560.61
### PRODUCT ###
< 44 > STOVE OIL= 2390
< 45 > LIGHT FUEL OIL= 26607
< 46 > DIESEL FUEL= 27991


### DISTILLATE COMPOSITION ###


               STOVE OIL    DIESEL FUEL   LFO


KEROSENE       1            .607          .489927
LCO            0            .139          .137928
LGO            0            .254          .372145
```

```
HEAVY FUEL OIL BLENDING
*** FEED ***
< 41 > LGO= 6.07349
< 35 > LCO= 2719
< 13 > HCO= 2569.9
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 8606.02

 *** PRODUCT ***
 < 47 > HEAVY FUEL OIL= 13901


                    OTHER PRODUCTS
 < 27 > NAPHTHA SPECIALTIES= 0
 < 36 > HVGO TO LUBE OIL= 63
 < 48 > RESID TO COKING= 0
 < 33 > VAC RESID TO ASPHALT PLANT= 9490
 < 61 > OLEFIN PETROCHEMICAL FEED= 0
 < 66 > NAPHTHA PETROCHEMICAL FEED= 1340
 < 67 > VGO PETROCHEMICAL FEED= 0
```

```
DISTILLATE DESULFURIZATION


                                                                                FINAL STREAM
          STREAM            TOTAL              FEED  TO  DDS                          % BYPASS     SULFUR WT%
                             BPCD        BPCD       Lbs/hr     SULFUR WT%                            8.52579E-03
          KEROSENE          37100.8     37100.8    436417       .17024                 0            .0772877
          LGO               17017.4     17017.4    215799       .767538                0            .684322
          LCO               10279.6     7195.73    101196       1.02822               29.9999       2.00859
          HCO               2569.9      0          0            2.00859               100           3.65395
          VAC RESIDUUM      8606.02     0          0            3.65395               100
```

```
***PRODUCT SLATES & SPECIFICATIONS***


                  JET FUEL B   JET FUEL A    STOVE OIL     LFO          DIESEL FUEL   HFO
          ______________________________________________________________________________

                                                                        27991         13901
          BPCD             1761        4403          2390         26607         .845468       1.0384
          S.G.             .753081     .799384       .80751       .852745       361.77
          ASTM 10%         205.693     311.542       344.699      368.64        393.454
          ASTM 20%         221.086     335.168       362.248      410.544       483.253
          ASTM 50%         261.77      398.193       411.026      518.215       603.483
          ASTM 90%         470.112     494.493       496.867      610.453
          RVP,psia         2.64159
          Sulfur Wt %      .0160971    9.00428E-03   8.51201E-03  .138738       .132374       2.96712
          Flash Point,F    63.9365     115.118       126.382      139.883       135.883
          Pour Point,F     -81.0092    -50.3801      -45.4097     -29.4895      -37.1989
          Cetane No.                                                            44.0897
          Visc @100F,cs    .782184     1.33251       1.47423      2.47833       2.15977       1251.42
          Visc @122F,cs    .690413     1.14929       1.26506      2.06077       1.81066       471.222
          Watsons K        12.0531     11.8587       11.8203      11.5299       11.5433       10.7961
          MeABP            207.872     391.00        409.613      490.473       469.565       949.06
```

```
GASOLINE


          LEADED REGULAR,BPCD          4915
          TEL Addition,cc/IG: 1.24
          RON / MON / (R+M)/2 (Clear)  88.9879 / 81.5165 / 85.2522
          RON / MON / (R+M)/2          93.0671 / 85.0249 / 89.046
          RVP,psia                     11.2753


          MMT Addition,mg/l: 10
          UNLEADED REGULAR,BPCD        34083
          RON / MON / (R+M)/2          94.19 / 83.8989 / 89.0445
          RVP,psia                     10.2409


          UNLEADED PREMIUM,BPCD        2956


          RON / MON / (R+M)/2          97.28 / 86.4623 / 91.8712
          RVP,psia                     9.04855


          AVIATION GASOLINE,BPCD       0
          RON / MON / (R+M)/2          93 / 90.8 / 91.9
          RVP,psia                     10
```

STREAMS

```
< 0 > CRUDE FEED= 136338                      < 1 > REDUCED CRUDE= 62022
< 2 > OVERHEAD= 8664.22                       < 3 > NAPHTHA= 11533.6
< 4 > KEROSENE= 37100.8                       < 5 > LGO= 17017.4
< 6 > HVGO= 43918                             < 7 > RESIDUUM= 18104
< 8 > FCCU FEED= 43855                        < 9 > REFORMER FEED= 8900
< 10 > CAT POLY FEED= 9150.04                 < 11 > ALKYLATION FEED= 0
< 12 > LCO= 10279.6                           < 13 > HCO= 2569.9
< 14 > CRACKED GAS= 22509.7                   < 15 > POLYMER= 3732.61
< 16 > LE FROM POLY (FOE)= 2874.71            < 17 > REFORMATE= 6715.87
< 18 > LE FROM CAT CRACKER (FOE)= 2907.72     < 19 > FUEL GAS (FOE)= 6136.01
< 20 > I-C4 FR. GAS PLANT= 0                  < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 4915                   < 23 > UNLEADED REGULAR= 34083
< 24 > UNLEADED PREMIUM= 2956                 < 25 > AVIATION GASOLINE= 0
< 26 > REFORMATE= 6715.87                     < 27 > NAPHTHA SPECIALTIES= 0
< 28 > LSR= 6471.02                           < 29 > LSR+ISO= 6224.58
< 30 > LSR= 193.71                            < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 62022                   < 33 > VAC RESID TO ASPHALT PLANT= 9498
< 34 > VAC RESIDUUM= 8606.02                  < 35 > LCO= 2719
< 36 > HVGO TO LUBE OIL= 63                   < 37 > HVGO= 0
< 38 > LCO= 7560.61                           < 39 > C3/C4 -FCCU= 9150.04
< 40 > LGO= 17011.4                           < 41 > LGO= 6.07349
< 42 > JET FUEL B= 1761                       < 43 > JET FUEL A= 4403
< 44 > STOVE OIL= 2390                        < 45 > LIGHT FUEL OIL= 26607
< 46 > DIESEL FUEL= 27991                     < 47 > HEAVY FUEL OIL= 13901
< 48 > RESID TO COKING= 0                     < 49 > REF C4 TO BLENDING = 2771.22
< 50 > ALKYLATE= 0                            < 51 > CRUDE LIGHT ENDS= 1.60865
< 52 > TOTAL PRODUCT= 129916                  < 53 > C2 % IN CRUDE FEED= .02451
< 54 > C3 % IN CRUDE FEED= .31962             < 55 > I-C4 % IN CRUDE FEED= .19662
< 56 > N-C4 % IN CRUDE FEED= 1.0679           < 57 > LE FROM REFORMER (FOE)= 1997.8
< 58 > NAPHTHA= 1285.58                       < 59 > KEROSENE= 4684.71
< 60 > KEROSENE= 32416.1                      < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 0                      < 63 > LE FROM ALKYL (FOE)= 0
< 64 > HVGO= 43855                            < 65 > LGO = 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 1348       < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                         < 69 > LSR= 6277.31
```

```
                               LIGHT ENDS BALANCE


                               *** FROM ***
              CRUDE UNIT    REFORMER     CAT CRACKER   POLY        ALKYL       ISO         TOTAL
C2  ,#/HR     175.236       1621.58      9286.37       0           0           0           11083.2
C3  ,#/HR     3224.65       4116.25      7903.24       8140.77     0           121.937     23506.8
IC4  ,#/HR    2206.2        2271.5       10515         20013.5     0           216.982     43223.2
NC4  ,#/HR    12407.6       3315.02      7464.57       7462.36     0           617.857     31267.4
H2  ,#/HR     0             4021.98      3629.74       0           0           0           7651.72
C1  ,#/HR     0             1621.58      3050.45       0           0           0           5472.03
H2S  ,#/HR    0             0            3751.96       0           0           0           3751.96
C2=  ,#/HR    0             0            5662.42       0           0           0           5662.42
C3=  ,#/HR    0             0            10279.8       0           0           0           10279.8
C4=  ,#/HR    0             0            28346.7       0           0           0           28346.7
TOTAL  ,#/HR  10013.7       16967.9      106690        35616.6     0           956.776     178245
BPCD (FOE)    1455.24       1997.81      8848.85       2874.71     0           77.1690     15253.8


                               *** TO ***
              POLY          ALKY         GAS BLEND     PC FEED     DDS         FUEL GAS    TOTAL
C2  ,#/HR     0             0            0             0           0           11083.2     11083.2
C3  ,#/HR     6636.76       0            0             0           0           16870.1     23506.9
IC4  ,#/HR    10509.5       0            11013.8       0           0           12099.9     43223.2
NC4  ,#/HR    7462.36       0            11379.5       0           0           12425.6     31267.4
H2  ,#/HR     0             0            0             0           5460.2      2191.53     7651.72
C1  ,#/HR     0             0            0             0           0           3472.03     5472.03
H2S  ,#/HR    0             ~0           0             0           0           3751.96     3751.96
C2=  ,#/HR    0             0            0             0           0           5662.42     5662.42
C3=  ,#/HR    14254.1       0            0             0           0           4025.72     10279.8
C4=  ,#/HR    28338.3       0            4.01748       0           0           4.3751      28346.7
TOTAL  ,#/HR  75201         0            23197.3       0           5460.2      74306.7     178245
BPCD (FOE)    5991.96       0            1065.59       0           1260.21     6136.01     15253.8
```

```
                             #### OVERALL MASS BALANCE ####
### FEED ###

                             BPCD                   #/HR


CRUDE                         136338                 1.7226E+06
BUTANE                        0                      0
TOTAL                         136338                 1.7226E+06




### PRODUCT ###


FUEL GAS (FOE)               6136.01                74386.7
MOTOR GASOLINE               41954                  445316
AVIATION TURBO FUELS         6164                   70589.7
DISTILLATES                  56988                  703359
HEAVY FUEL OIL               13901                  210272
OTHER PRODUCTS               10909                  161204
H2 TO DESULFURIZERS (FOE)    1260.21                5460.2
COKE (FOE)                   2774.57                52094.8
TOTAL                        140087                 1.72268E+06
```

```
TIME:05.55.22 DATE:SUNJUN171984169 66
REFINERY SIMULATION PROGRAM

CASE:QUEBAS20 REGION:QUEBEC

#### FEED BLEND ####

               CRUDE ORIGIN             LV %          BPCD

                FRONTIER                16.8          46707.5
                VENEZH                  11.65         32389.4
                ARABH                   6.95          19322.4
                CANDNH                  27.3          75899.6
                SYNCRUDE                16.3          45317.4
                MEXH                    11.6          32250.4
                CONDENSA                9.4           26133.9
                  No.  MBP          LV %       S.G.       API         SULFUR WT%  BPCD         Lbs/hr FEED     Lbs/hr SULFUR
                  Total             100                                           278021        3.58179E+06     64672
                  Average                    .884407     28.4943        1.00558

                    #### MATERIAL BALANCE ####


                 CRUDE UNIT
                  No. Name          BPCD        Lbs/hr        IBP          EBP          S.G.        API           SULFUR WT%  Lbs/hr Su
                             ### FEED ###
                  0   CRUDE FEED    278021      3.58179E+06   60           1460         .884408     28.4941       1.00558     64672
                             ### PRODUCT ###
                  2   OVERHEAD      24122.3     225641        60           170.304      .642139     88.8572       .0406065    91.625
                  29  LSR           19004.1     183502        60           170.304      .662863     81.968        .0498816    91 5338
                  3   NAPHTHA       36381.3     392450        170.394      319.814      .740518     59.5825       .0843461    331.016
                  4   KEROSENE      50390.6     606964        319.814      540          .826881     39.625        .424434     2576.16
                  5   LGO           32416.2     417877        540          660          .884944     28.3971       1.02294     4274.63
                  1   REDUCED CRUDE 134710      1.93886E+06   660          1460         .988044     11.7123       2.96043     57398.6


                 VACUUM UNIT
                  No. Name          BPCD        Lbs/hr        IBP          EBP          S.G.        API           SULFUR WT%  Lbs/hr Su
                             ### FEED ###
                  32  REDUCED CRUDE 134710      1.93886E+06   660          1460         .988044     11.7123       2.96043     57398.6
                             ### PRODUCT ###
                  6   HVGO          87252.1     1.19578E+06   660          1050         .940819     18.9009       1.9963      23871.4
                  7   RESIDUUM      47458.1     743001        1050         1460         1.07487     .143829       4.51195     33527.5


                 CAT CRACKER
                  No. Name          BPCD        Lbs/hr        IBP          EBP          S.G.        API           SULFUR WT%  Lbs/hr Su
                             ### FEED ###
                  65  LGO           10029.9     129295        540          660          .884944     28.3971       1.02294     1322.61
                  64  HVGO          81151.1     1.11217E+06   660          1050         .940819     18.9009       1.9963      22202.2
                             ### TOTAL FEED ###
                  8   FCCU FEED     91181       1.24146E+06   540          1050         .934673     19.8898       1.89493     23524.8
                             ### PRODUCT ###
                  12  LCO           16412.6     238657        430          650          .998221     10.2522       2.98762     7130.17
                  13  HCO           4103.15     65149.3       650          747.086      1.08999     -1.6823       4.72043     3075.33
                  14  CRACKED GAS   47684.9     522912                                  .752796     56.4659       .213805     1118.01
                  39  C3/C4 -FCCU   20554.5     169539                                  .566231     118.398       0           0
                 ### PRODUCT ###
                 < 18 > LE FROM CAT CRACKER (FOE)= 8338.91
                 AVAILABLE C3/C4 OLEFINS= 20833.8
                 CONVERSION Wt%= 75.5284     CONVERSION Vol %= 77.5
                 COKE, WT% 12.4647
                 COKE  ,0/HR 154024           Sulfur in Flue Gas,Lbs/hr= 1197.76
```

```
CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 19000
*** PRODUCT ***
< 15 > POLYMER= 7644.45
< 16 > LE FROM POLY (FOE)= 6106.52


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 2237.4
< 62 > C3/C4 TO ALKYL= 1554.49
< 20 > I-C4 FR. GAS PLANT= 682.913
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 1500.23
< 63 > LE FROM ALKYL (FOE)= 209.097


CATALYTIC REFORMER UNIT
  No. Name          BPCD      Lbs/hr      IBP       EBP       S.G.      API       SULFUR WT%  Lbs/hr Su
             *** FEED ***
 9  REFORMER FEED 33000     355975      170.304   319.814   .740518   59.5825      0           0
             *** PRODUCT ***
 17  REFORMATE    25727     298852                          .797437   45.9436      0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 6677.58
CONVERSION(LV%)= 77.9606    Severity (RON Clear)= 97.3  FEED KW= 12.0545


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 24122.3
< 57 > LE FROM REFORMER (FOE)= 6677.58
< 18 > LE FROM CAT CRACKER (FOE)= 8338.91
< 16 > LE FROM POLY (FOE)= 6106.52
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 18953.1
< 20 > I-C4 FR. GAS PLANT= 682.913
< 49 > REF C4 TO BLENDING = 5395.14
< 69 > LSR= 18609.7


ISOMERIZATION UNIT (TOTAL RECYCLE)
*** FEED ***
< 69 > LSR= 18609.7
*** PRODUCT ***
< 29 > LSR+ISO= 18401.3


*** BY-PASS= 30 %   ***


GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 18401.3
< 26 > REFORMATE= 8177.99
< 50 > ALKYLATE= 1500.23
< 15 > POLYMER= 7644.45
< 14 > CRACKED GAS= 47604.9
< 49 > REF C4 TO BLENDING = 5395.14
< 60 > IMPORTED C4= 0
*** PRODUCT ***
```

```
        < 22 > LEADED REGULAR= 26456
        < 23 > UNLEADED REGULAR= 53805
        < 24 > UNLEADED PREMIUM= 7925
        < 25 > AVIATION GASOLINE= 698


        *** GASOLINE COMPOSITION ***


                  LR            UR            UP            AV


LSR               .476934       .107491       0             0
CRACKED GAS       .482088       .64           .0625302      0
REFORMATE         0             .0308474      .760177       0
POLYMER           0             .142077       0             0
ALKYLATE          0             1.93945E-03   .1            .9786
C4                .0409775      .0696453      .0692932      .0214

       TURBO FUEL BLENDING
       *** FEED ***
       < 30 > LSR= 394.35
       < 58 > NAPHTHA= 3381.3
       < 59 > KEROSENE= 10942.4
       *** PRODUCT ***
       < 42 > JET FUEL B= 3585
       < 43 > JET FUEL A= 11133


       *** TURBO FUEL COMPOSITION ***


                     NAPHTHA BASE  KEROSENE BASE


       LSR           .11           0
       NAPHTHA       .555          .125
       KEROSENE      .335          .875


       DISTILLATE BLENDING
       *** FEED ***
       < 60 > KEROSENE= 39448.3
       < 40 > LGO= 14573.5
       < 30 > LCO= 4412.58
       *** PRODUCT ***
       < 44 > STOVE OIL= 1384
       < 45 > LIGHT FUEL OIL= 20505
       < 46 > DIESEL FUEL= 36545
```

```
        *** DISTILLATE COMPOSITION ***


                      STOVE OIL     DIESEL FUEL   LFO


        KEROSENE        1             .7            .608751
        LCO             0             0             .215195
        LGO             0             .3            .176054

        HEAVY FUEL OIL BLENDING
        *** FEED ***
        < 41 > LGO= 7812.77
        < 35 > LCO= 12000
        < 13 > HCO= 4103.15
        < 37 > HVGO= 0
        < 31 > REDUCED CRUDE= 0







        < 34 > VAC RESIDUUM= 31985.1
        *** PRODUCT ***
        < 47 > HEAVY FUEL OIL= 55901


                    OTHER PRODUCTS
        < 27 > NAPHTHA SPECIALTIES= 17549
        < 36 > HVGO TO LUBE OIL= 3774
        < 48 > RESID TO COKING= 0
        < 33 > VAC RESID TO ASPHALT PLANT= 15473
        < 61 > OLEFIN PETROCHEMICAL FEED= 0
        < 66 > NAPHTHA PETROCHEMICAL FEED= 0
        < 67 > VGO PETROCHEMICAL FEED= 2327

DISTILLATE DESULFURIZATION

        STREAM              TOTAL               FEED  TO  DDS                                      FINAL STREAM
                             BPCD       BPCD      Lbs/hr    SULFUR WT%            % BYPASS        SULFUR WT%
        KEROSENE            50390.6     50390.6   606964     .424434              0               .0213076
        LGO                 22386.3     22386.3   208581     1.02294              -8.72464E-06    .103244
        LCO                 16412.6     13130.1   190926     2.98762               19.9999        .85492
        HCO                 4103.15     0         0          4.72043               100            4.72043
        VAC RESIDUUM        31985.1     0         0          4.51195               100            4.51195
```

```
***PRODUCT SLATES & SPECIFICATIONS***


                 JET FUEL B   JET FUEL A   STOVE OIL   LFO          DIESEL FUEL   HFO
_____________________________________________________________________________________

BPCD             3585         11133        1384        20505        36545         55901
S.G.             .760907      .816086      .826981     .873975      .8443         1.03298
ASTM 10%         207.305      333.622      381.837     398.114      393.59
ASTM 20%         226.029      359.945      395.083     424.913      416.925
ASTM 50%         282.266      424.92       440.242     480.168      484.593
ASTM 90%         470.293      499.728      502.837     598.299      603.43
RVP,psia         2.74817
Sulfur Wt %      .0500633     .0283816     .0212217    .236067      .0467141      3.23768
Flash Point,F    64.6652      127.463      144.16      152.977      150.46
Pour Point,F     -85.0346     -50.38       -44.6892    -52.9178     -29.634
Cetane No.                                                          45.5817
Visc @100F,cs    .799874      1.51233      1.7279      2.42745      2.29149       645.754
Visc @122F,cs    .705131      1.29473      1.46843     2.01063      1.91622       271.955
Watsons K        11.9513      11.7105      11.6544     11.2176      11.6008       10.7802
MeABP            292.04       412.043      434.959     482.326      479.623       921


GASOLINE


                 LEADED REGULAR,BPCD            26456
                 TEL Addition,cc/IG: 1.24
                 RON / MON / (R+M)/2 (Clear)    89.5981 / 82.4733 / 86.0357
                 RON / MON / (R+M)/2            93.9415 / 86.0126 / 89.9771
                 RVP,psia                       12.4834


                 MMT Addition,mg/l: 0
                 UNLEADED REGULAR,BPCD          53805
                 RON / MON / (R+M)/2            93.9771 / 83.9834 / 80.9803
                 RVP,psia                       10.3998






                 UNLEADED PREMIUM,BPCD          7925
                 RON / MON / (R+M)/2            96.3999 / 87.2656 / 91.8328
                 RVP,psia                       9.79749


                 AVIATION GASOLINE,BPCD         698
                 RON / MON / (R+M)/2            93 / 90.8 / 91.9
                 RVP,psia                       10
```

STREAMS

```
< 0 > CRUDE FEED= 278021                          < 1 > REDUCED CRUDE= 134710
< 2 > OVERHEAD= 24122.3                           < 3 > NAPHTHA= 36381.3
< 4 > KEROSENE= 50390.6                           < 5 > LGO= 32416.2
< 6 > HVGO= 87252.1                               < 7 > RESIDUUM= 47458.1
< 8 > FCCU FEED= 91181                            < 9 > REFORMER FEED= 33000
< 10 > CAT POLY FEED= 19000                       < 11 > ALKYLATION FEED= 2237.4
< 12 > LCO= 16412.6                               < 13 > HCO= 4103.15
< 14 > CRACKED GAS= 47604.9                       < 15 > POLYMER= 7644.45
< 16 > LE FROM POLY (FOE)= 6106.52                < 17 > REFORMATE= 25727
< 18 > LE FROM CAT CRACKER (FOE)= 8338.91         < 19 > FUEL GAS (FOE)= 18953.1
< 20 > I-C4 FR. GAS PLANT= 682.913                < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 26456                      < 23 > UNLEADED REGULAR= 53805
< 24 > UNLEADED PREMIUM= 7925                     < 25 > AVIATION GASOLINE= 698
< 26 > REFORMATE= 8177.99                         < 27 > NAPHTHA SPECIALTIES= 17549
< 28 > LSR= 19004.1                               < 29 > LSR+ISO= 18401.3
< 30 > LSR= 394.35                                < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 134710                      < 33 > VAC RESID TO ASPHALT PLANT= 15473
< 34 > VAC RESIDUUM= 31985.1                      < 35 > LCO= 12000
< 36 > HVGO TO LUBE OIL= 3774                     < 37 > HVGO= 0
< 38 > LCO= 4412.58                               < 39 > C3/C4 -FCCU= 20554.5
< 40 > LGO= 14573.5                               < 41 > LGO= 7812.77
< 42 > JET FUEL B= 3585                           < 43 > JET FUEL A= 11133
< 44 > STOVE OIL= 1384                            < 45 > LIGHT FUEL OIL= 20505
< 46 > DIESEL FUEL= 36545                         < 47 > HEAVY FUEL OIL= 55901
< 48 > RESID TO COKING= 0                         < 49 > REF C4 TO BLENDING = 5395.14
< 50 > ALKYLATE= 1580.23                          < 51 > CRUDE LIGHT ENDS= 1.84108
< 52 > TOTAL PRODUCT= 257060                      < 53 > C2 % IN CRUDE FEED= .04423
< 54 > C3 % IN CRUDE FEED= .277635                < 55 > I-C4 % IN CRUDE FEED= .21544
< 56 > N-C4 % IN CRUDE FEED= 1.30377              < 57 > LE FROM REFORMER (FOE)= 6677.58
< 58 > NAPHTHA= 3381.3                            < 59 > KEROSENE= 10942.4
< 60 > KEROSENE= 39448.3                          < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 1554.49                    < 63 > LE FROM ALKYL (FOE)= 209.097
< 64 > HVGO= 81151.1                              < 65 > LGO = 10029.9
< 66 > NAPHTHA PETROCHEMICAL FEED= 0              < 67 > VGO PETROCHEMICAL FEED= 2327
< 68 > IMPORTED C4= 0                             < 69 > LSR= 10609.7
```

```
                              LIGHT ENDS BALANCE


                               *** FROM ***
               CRUDE UNIT    REFORMER     CAT CRACKER   POLY         ALKYL        ISO          TOTAL
C2   ,#/HR      644.847       5284.38      27283.7      0            0            0             33212.9
C3   ,#/HR      5711.93       13720.9      18877.5      17595.8      1183.16      481.992       57571.3
IC4  ,#/HR      4929.5        7968.10      41540.8      41018.8      0            857.686       96315
NC4  ,#/HR      30890.1       11628.7      18677.9      17033.9      1393.63      2442.27       82066.5
H2   ,#/HR      0             13237.1      10625        0            0            0             23862.1
C1   ,#/HR      0             5284.38      11312.8      0            0            0             16597.2
H2S  ,#/HR      0             0            11691.3      0            0            0             11691.3
C2=  ,#/HR      0             0            16636.4      0            0            0             16636.4
C3=  ,#/HR      0             0            35100.3      0            0            0             35100.3
C4=  ,#/HR      0             0            68389.2      0            0            0             68389.2
TOTAL  ,#/HR    42176.4       57123.6      260135       75648.5      2576.79      3781.95       441442
BPCD (FOE;      3405.75       6677.57      21688.7      6106.52      209.096      305.037       38392.7


                               *** TO ***
               POLY          ALKY         GAS BLEND     PC FEED      DDS          FUEL GAS     TOTAL
C2   ,#/HR      0             0            0            0            0             33212.9      33212.9
C3   ,#/HR      14461.4       1183.16      0            0            0             41926.8      57571.3
IC4  ,#/HR      37884.4       8719.89      19701.7      0            0             30009        96315
NC4  ,#/HR      17033.9       1393.63      25221.8      0            0             38417.2      82066.5
H2   ,#/HR      0             0            0            0            7963.12       15899        23862.1
C1   ,#/HR      0             0            0            0            0             16597.2      16597.2
H2S  ,#/HR      0             0            0            0            0             11691.3      11691.3
C2=  ,#/HR      0             0            0            0            0             16636.4      16636.4
C3=  ,#/HR      24968.4       2042.79      0            0            0             8089.15      35100.3
C4=  ,#/HR      62369.6       5102.78      363.333      0            0             553.534      68389.2
TOTAL  ,#/HR    156718        18442.3      45286.8      0            7963.12       213033       441442
BPCD (FOE)      12486.6       1472.96      3642.17      0            1837.89       18953.1      38392.7
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                         **** OVERALL MASS BALANCE ****
*** FEED ***


                         BPCD                       #/HR


CRUDE                     278021                     3.58179E+06
BUTANE                    0                          0
TOTAL                     278021                     3.58179E+06




*** PRODUCT ***


FUEL GAS (FOE)             18953.1                    213033
MOTOR GASOLINE             88884                      936043
AVIATION TURBO FUELS       14718                      172085
DISTILLATES                58434                      727188
HEAVY FUEL OIL             55901                      841166
OTHER PRODUCTS             39123                      529738
H2 TO DESULFURIZERS (FOE)  1837.89                    7963.12
COKE (FOE)                 8245.93                    154824
TOTAL                      286097                     3.58204E+06
```

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TIME:03.42.26 DATE:MONJUN111984163 60
REFINERY SIMULATION PROGRAM

CASE:QUEBAS21 REGION:QUEBEC

**** FEED BLEND ****

            CRUDE ORIGIN               LV %            BPCD

             FRONTIER                  16.8           46583.2
             VENEZH                    11.65          32303.3
             ARABH                     6.95           19271
             CANDNH                    27.3           75697.8
             SYNCRUDE                  16.3           45196.8
             MEXH                      11.6           32164.6
             CONDENSA                  9.4            26064.4
               No.  MBP          LV %        S.G.        API          SULFUR WT%  BPCD          Lbs/hr FEED     Lbs/hr SULFUR
               Total             100                                              277281        3.57226E+06      64500
               Average                     .884407     28.4942       1.80558

                **** MATERIAL BALANCE ****


             CRUDE UNIT
               No. Name          BPCD        Lbs/hr       IBP          EBP          S.G.      API            SULFUR WT%  Lbs/hr Su
                         *** FEED ***
              0   CRUDE FEED     277281      3.57226E+06  60           1460        .884409   28.494          1.80558      64500
                         *** PRODUCT ***
              2   OVERHEAD       23867       223077       60           169.414     .641632   89.0315         .040443      90.2108
              28  LSR            18762.4     181058       60           169.414     .662458   82.0985         .0498434     90.2453
              3   NAPHTHA        36281.3     391179       169.414      319.012     .740154   59.6764         .0840017     328.597
              4   KEROSENE       50451       607533       319.012      540         .826666   39.6695         .423334      2571.89
              5   LGO            32330       416765       540          660         .884944   28.3971         1.02294      4263.26
              1   REDUCED CRUDE 134352       1.93371E+06  660          1460        .988044   11.7123         2.96043      57246


             VACUUM UNIT
               No. Name          BPCD        Lbs/hr       IBP          EBP          S.G.      API            SULFUR WT%  Lbs/hr Su
                         *** FEED ***
              32  REDUCED CRUDE 134352       1.93371E+06  660          1460        .988044   11.7123         2.96043      57246
                         *** PRODUCT ***
              6   HVGO           87019.8     1.1926E+06   660          1050        .940819   18.9009         1.9963       23807.8
              7   RESIDUUM       47332.1     741109       1050         1460        1.07487   .143829         4.51195      33438.5


             CAT CRACKER
               No. Name          BPCD        Lbs/hr       IBP          EBP          S.G.      API            SULFUR WT%  Lbs/hr Su
                         *** FEED ***
              65  LGO            10001.2     128925       540          660         .884944   28.3971         1.02294      1318.83
              64  HVGO           80918.8     1.10898E+06  660          1050        .940819   18.9009         1.9963       22138.7
                         *** TOTAL FEED ***
              8   FCCU FEED      90920       1.23791E+06  540          1050        .934673   19.8898         1.09493      23457.5
                         *** PRODUCT ***
              12  LCO            16511.1     240030       430          650         .997975   10.2871         2.96913      7126.01
              13  HCO            4127.77     65505.4      650          748.726     1.08941   -1.61317        4.69123      3073.01
              14  CRACKED GAS    47488.5     520613                                .752587   56.5181         .214674      1117.62
              39  C3/C4 -FCCU    20689.4     170651                                .566229   118.399         0            0
             *** PRODUCT ***
             < 18 > LE FROM CAT CRACKER (FOE)= 8891
             AVAILABLE C3/C4 OLEFINS= 20704.5
             CONVERSION Wt%= 75.3185     CONVERSION Vol %= 77.3
             COKE, WT% 12.406
             COKE  ,0/HR 153654          Sulfur in Flue Gas,Lbs/hr= 1109.66
```

```
CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 18600
*** PRODUCT ***
< 15 > POLYMER= 7483.67
< 16 > LE FROM POLY (FOE)= 5977.75


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 3007.42
< 62 > C3/C4 TO ALKYL= 2089.42
< 20 > I-C4 FR. GAS PLANT= 918.001
< 21 > I-C4 IMPORTED= 0
*** PRODUCT ***
< 50 > ALKYLATE= 2124.08
< 63 > LE FROM ALKYL (FOE)= 281.045


CATALYTIC REFORMER UNIT
 No. Name           BPCD       Lbs/hr       IBP        EBP        S.G.       API          SULFUR WT%  Lbs/hr Su
          *** FEED ***
 9  REFORMER FEED 32900       354722       169.414    319.012    .740154   59.6764       0           0
          *** PRODUCT ***
 17  REFORMATE    25758.8     298683                             .796003   46.2631       0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 6541.76
CONVERSION(LV%)= 78.2942    Severity (RON Clear)= 97    FEED KW= 12.0561


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 23867
< 57 > LE FROM REFORMER (FOE)= 6541.76
< 18 > LE FROM CAT CRACKER (FOE)= 8091
< 16 > LE FROM POLY (FOE)= 5977.75
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 18299.2
< 20 > I-C4 FR. GAS PLANT= 918.001
< 49 > REF C4 TO BLENDING = 5378.98
< 69 > LSR= 18368


ISOMERIZATION UNIT (TOTAL RECYCLE)
*** FEED ***
< 69 > LSR= 18368
*** PRODUCT ***
< 29 > LSR+ISO= 18199


*** BY-PASS= 42.5 %   ***
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```
GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 18199
< 26 > REFORMATE= 8209.76
< 50 > ALKYLATE= 2124.08
< 15 > POLYMER= 7483.67
< 14 > CRACKED GAS= 47488.5
< 49 > REF C4 TO BLENDING = 5378.98
< 68 > IMPORTED C4= 0
*** PRODUCT ***


< 22 > LEADED REGULAR= 8820
< 23 > UNLEADED REGULAR= 71441
< 24 > UNLEADED PREMIUM= 7925
< 25 > AVIATION GASOLINE= 698


*** GASOLINE COMPOSITION ***


             LR          UR          UP          AV


LSR          .396393     .205804     0           0
CRACKED GAS  .471595     .58         .238894     0
REFORMATE    .085078     .0367471    .609985     0
POLYMER      0           .104753     0           0
ALKYLATE     0           .0112919    .08         .9786
C4           .0469344    .0614039    .0711215    .0214


TURBO FUEL BLENDING
*** FEED ***
< 30 > LSR= 394.35
< 58 > NAPHTHA= 3381.3
< 59 > KEROSENE= 10942.4
*** PRODUCT ***
< 42 > JET FUEL B= 3585
< 43 > JET FUEL A= 11133


*** TURBO FUEL COMPOSITION ***


               NAPHTHA BASE  KEROSENE BASE


LSR            .11           0
NAPHTHA        .555          .125
KEROSENE       .335          .875


DISTILLATE BLENDING
*** FEED ***
< 60 > KEROSENE= 39508.7
< 40 > LGO= 18414.6
< 38 > LCO= 511.060
*** PRODUCT ***
< 44 > STOVE OIL= 1384
< 45 > LIGHT FUEL OIL= 20505
< 46 > DIESEL FUEL= 36545
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*** DISTILLATE COMPOSITION ***


              STOVE OIL     DIESEL FUEL   LFO


KEROSENE      1             .7            .611695
LCO           0             0             .0249241
LGO           0             .3            .363381

HEAVY FUEL OIL BLENDING
*** FEED ***
< 41 > LGO= 3914.14
< 35 > LCO= 16000
< 13 > HCO= 4127.77
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0









< 34 > VAC RESIDUUM= 31859.1
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 55901


              OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 17549
< 36 > HVGO TO LUBE OIL= 3774
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 15473
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 0
< 67 > VGO PETROCHEMICAL FEED= 2327

DISTILLATE DESULFURIZATION


       STREAM         TOTAL               FEED  TO  DDS                                      FINAL STREAM
                       BPCD        BPCD        Lbs/hr      SULFUR WT%          % BYPASS      SULFUR WT%
       KEROSENE       50451        50451       607533       .423334            0             .0212522
       LGO            22320.8      22320.8     287048       1.02294            0             .103245
       LCO            16511.1      13208.9     192024       2.96913            19.9999       .849514
       HCO            4127.77      0           0            4.69123            100           4.69123
       VAC RESIDUUM   31859.1      0           0            4.51195            100           4.51195
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***PRODUCT SLATES & SPECIFICATIONS***

                  JET FUEL B   JET FUEL A   STOVE OIL    LFO          DIESEL FUEL  HFO
_______________________________________________________________________________________

BPCD              3585         11133        1384         20505        36545        55901
S.G.              .760589      .815852      .826666      .852113      .844149      1.04064
ASTM 10%          206.815      332.83       381.078      396.897      392.793
ASTM 20%          225.384      359.211      394.394      424.708      416.27
ASTM 50%          281.517      424.407      439.828      502.334      484.373
ASTM 90%          470.047      499.638      502.75       600.675      603.439
RVP,psia          2.71207
Sulfur Wt %       .0578506     .0282923     .0211667     .0754324     .046681      3.25297
Flash Point,F     64.3937      127.021      143.746      152.327      150.024
Pour Point,F      -85.206      -50.5253     -44.8161     -27.7017     -29.7435
Cetane No.                                                            45.6072
Visc @100F,cs     .797391      1.5078       1.72302      2.5044       2.28600      625.009
Visc @122F,cs     .70303       1.29105      1.46451      2.00160      1.91198      260.001
Watsons K         11.9528      11.7116      11.6554      11.5459      11.6014      10.6852
MeABP             291.388      412.331      434.498      492.299      479.267      914.9


GASOLINE


        LEADED REGULAR,BPCD             8820
        TEL Addition,cc/IG: 1.24
        RON / MON / (R+M)/2 (Clear)     89.8688 / 82.0896 / 85.9792
        RON / MON / (R+M)/2             94.1315 / 85.5438 / 89.8377
        RVP,psia                        11.0968


        MMT Addition,mg/l: 18
        UNLEADED REGULAR,BPCD           71441
        RON / MON / (R+M)/2             93.83 / 84.1475 / 88.9888
        RVP,psia                        10.8957


        UNLEADED PREMIUM,BPCD           7925
        RON / MON / (R+M)/2             96.89 / 86.8017 / 91.8459
        RVP,psia                        9.70228


        AVIATION GASOLINE,BPCD          690
        RON / MON / (R+M)/2             93 / 90.8 / 91.9
        RVP,psia                        10
```

```
                         STREAMS
                ________________________

< 0 > CRUDE FEED= 277281                    < 1 > REDUCED CRUDE= 134352
< 2 > OVERHEAD= 23867                       < 3 > NAPHTHA= 36281.3
< 4 > KEROSENE= 50451                       < 5 > LGO= 32330
< 6 > HVGO= 87019.8                         < 7 > RESIDUUM= 47332.1
< 8 > FCCU FEED= 90920                      < 9 > REFORMER FEED= 32900
< 10 > CAT POLY FEED= 18600                 < 11 > ALKYLATION FEED= 3007.42
< 12 > LCO= 16511.1                         < 13 > HCO= 4127.77
< 14 > CRACKED GAS= 47488.5                 < 15 > POLYMER= 7483.67
< 16 > LE FROM POLY (FOE)= 5977.75          < 17 > REFORMATE= 25758.8
< 18 > LE FROM CAT CRACKER (FOE)= 8091      < 19 > FUEL GAS (FOE)= 18299.2
< 20 > I-C4 FR. GAS PLANT= 918.001          < 21 > I-C4 IMPORTED= 0
< 22 > LEADED REGULAR= 6820                 < 23 > UNLEADED REGULAR= 71441
< 24 > UNLEADED PREMIUM= 7925               < 25 > AVIATION GASOLINE= 698
< 26 > REFORMATE= 8209.76                   < 27 > NAPHTHA SPECIALTIES= 17549
< 28 > LSR= 18762.4                         < 29 > LSR+ISO= 18199
< 30 > LSR= 394.35                          < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 134352                < 33 > VAC RESID TO ASPHALT PLANT= 15473
< 34 > VAC RESIDUUM= 31859.1                < 35 > LCO= 16000
< 36 > HVGO TO LUBE OIL= 3774               < 37 > HVGO= 0
< 38 > LCO= 511.068                         < 39 > C3/C4 -FCCU= 20689.4
< 40 > LGO= 18414.6                         < 41 > LGO= 3914.14
< 42 > JET FUEL B= 3585                     < 43 > JET FUEL A= 11133
< 44 > STOVE OIL= 1384                      < 45 > LIGHT FUEL OIL= 20505
< 46 > DIESEL FUEL= 36545                   < 47 > HEAVY FUEL OIL= 55901
< 48 > RESID TO COKING= 0                   < 49 > REF C4 TO BLENDING = 5378.98
< 50 > ALKYLATE= 2124.08                    < 51 > CRUDE LIGHT ENDS= 1.84108
< 52 > TOTAL PRODUCT= 257060                < 53 > C2 % IN CRUDE FEED= .04423
< 54 > C3 % IN CRUDE FEED= .277635          < 55 > I-C4 % IN CRUDE FEED= .21544
< 56 > N-C4 % IN CRUDE FEED= 1.30377        < 57 > LE FROM REFORMER (FOE)= 6541.76
< 58 > NAPHTHA= 3381.3                      < 59 > KEROSENE= 10942.4
< 60 > KEROSENE= 39508.7                    < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 2089.42              < 63 > LE FROM ALXYL (FOE)= 281.045
< 64 > HVGO= 80918.8                        < 65 > LGO = 10001.2
< 66 > NAPHTHA PETROCHEMICAL FEED= 0        < 67 > VGO PETROCHEMICAL FEED= 2327
< 68 > IMPORTED C4= 0                       < 69 > LSR= 18368
```

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                              LIGHT ENDS BALANCE

                                   *** FROM ***
                CRUDE UNIT   REFORMER    CAT CRACKER   POLY       ALKYL      ISO        TOTAL
C2   ,#/HR      643.132      5153.32     27025         0          0          0          32821.5
C3   ,#/HR      5696.74      13427.9     18751.8       17218.8    1589.58    390.78     57075.6
IC4  ,#/HR      4916.39      7878.14     41280.9       40153.3    0          695.377    94924.1
NC4  ,#/HR      30000        11497.3     18568.6       16681.2    1873.87    1980.09    81409.1
H2   ,#/HR      0            12928.9     10521.1       0          0          0          23450
C1   ,#/HR      0            5153.32     11205.5       0          0          0          16358.8
H2S  ,#/HR      0            0           11634.8       0          0          0          11634.8
C2=  ,#/HR      0            0           16478.7       0          0          0          16478.7
C3=  ,#/HR      0            0           34901.9       0          0          0          34901.9
C4=  ,#/HR      0            0           67951.5       0          0          0          67951.5
TOTAL ,#/HR     42064.3      56038.9     258320        74053.3    3463.45    3066.25    437006
BPCD (FOE)      3396.7       6541.76     21530.2       5977.75    281.045    247.311    37974.7


                                   *** TO ***
                POLY         ALKY        GAS BLEND     PC FEED    DDS        FUEL GAS   TOTAL
C2   ,#/HR      0            0           0             0          0          32821.5    32821.5
C3   ,#/HR      14150.4      1589.58     0             0          0          41335.6    57075.6
IC4  ,#/HR      37084.9      11721.1     19104.5       0          0          27013.6    94924.1
NC4  ,#/HR      16681.2      1873.87     26037.3       0          0          36816.7    81409.1
H2   ,#/HR      0            0           0             0          7968.42    15481.6    23450
C1   ,#/HR      0            0           0             0          0          16358.8    16358.8
H2S  ,#/HR      0            0           0             0          0          11634.8    11634.8
C2=  ,#/HR      0            0           0             0          0          16478.7    16478.7
C3=  ,#/HR      24456.4      2747.29     0             0          0          7698.23    34901.9
C4=  ,#/HR      61044.6      6857.41     20.4892       0          0          29.0045    67951.5
TOTAL ,#/HR     153418       24789.2     45162.3       0          7968.42    205669     437006
BPCD (FOE)      12223.6      1979.89     3632.94       0          1839.11    18299.2    37974.7
```

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                                   **** OVERALL MASS BALANCE ****
*** FEED ***


                                   BPCD                         #/HR


CRUDE                              277281                       3.57226E+06
BUTANE                             0                            0
TOTAL                              277281                       3.57226E+06




*** PRODUCT ***


FUEL GAS (FOE)                     18299.2                      205669
MOTOR GASOLINE                     88804                        935846
AVIATION TURBO FUELS               14718                        172030
DISTILLATES                        58434                        720573
HEAVY FUEL OIL                     55981                        847404
OTHER PRODUCTS                     39123                        529372
H2 TO DESULFURIZERS (FOE)          1839.11                      7968.42
COKE !FOE)                         8183.61                      153654
TOTAL                              285382                       3.57252E+06
```

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TIME:02.55.41 DATE:SUNJUN171984169 66
REFINERY SIMULATION PROGRAM

CASE:ONTBAS20 REGION:ONTARIO

**** FEED BLEND ****

          CRUDE ORIGIN             LV %           BPCD


           CANDNL                  49             219953
           CANDNH                  9.2            41297.2
           SYNCRUDE                30.8           138256
           CONDENSA                11             49377.1
            No.  MBP          LV %       S.G.       API          SULFUR WT%  BPCD           Lbs/hr FEED     Lbs/hr SULFUR
            Total            100                                            448883          5.49906E+06     26524.4
            Average                    .84098     36.7562       .482344

               **** MATERIAL BALANCE ****


          CRUDE UNIT
           No. Name          BPCD          Lbs/hr        IBP          EBP          S.G.          API          SULFUR WT%   Lbs/hr Su
                       *** FEED ***
           0   CRUDE FEED    448883        5.49906E+06   60           1300         .840979       36.7563      .482344      26524.4
                       *** PRODUCT ***
           2   OVERHEAD      54422.8       508388        60           169.937      .641274       89.1544      .0289395     147.125
           28  LSR           41022.7       399398        60           169.937      .668362       80.2116      .0368175     147.048
           3   NAPHTHA       82650.8       906884        169.937      321.673      .753242       56.3546      .0268476     243.477
           4   KEROSENE      108462        1.31717E+06   321.673      560          .833667       38.232       .106901      1408.06
           5   LGO           48289.9       621284        560          660          .88321        28.711       .312237      1939.88
           1   REDUCED CRUDE 155057        2.14534E+06   660          1300         .949805       17.478       1.06211      22785.9


          VACUUM UNIT
           No. Name          BPCD          Lbs/hr        IBP          EBP          S.G.          API          SULFUR WT%   Lbs/hr Su
                       *** FEED ***
           32  REDUCED CRUDE 155057        2.14534E+06   660          1300         .949805       17.478       1.06211      22785.9
                       *** PRODUCT ***
           6   HVGO          124246        1.67073E+06   660          1050         .923111       21.786       .618341      10330.8
           7   RESIDUUM      30811.1       474615        1050         1300         1.05746       2.31122      2.62443      12455.9


          CAT CRACKER
           No. Name          BPCD          Lbs/hr        IBP          EBP          S.G.          API          SULFUR WT%   Lbs/hr Su
                       *** FEED ***
           65  LGO           30633.7       394125        560          660          .88321        28.711       .312237      1230.6
           64  HVGO          98079.3       1.31807E+06   660          1050         .923111       21.786       .618341      8155.1
                       *** TOTAL FEED ***
           8   FCCU FEED     128713        1.71299E+06   560          1050         .913615       23.3792      .547913      9385.71
                       *** PRODUCT ***
           12  LCO           28594.1       289307        430          650          .964375       15.2272      .940254      2743.37
           13  HCO           5140.52       80795.1       650          736.422      1.07729       -.151901     1.49824      1210.5
           14  CRACKED GAS   73525.6       802658                                  .749414       57.3142      .0538167     431.964
           39  C3/C4 -FCCU   20095.4       164959                                  .563521       119.6        0            0
          *** PRODUCT ***
          < 18 > LE FROM CAT CRACKER (FOE)= 19108
          AVAILABLE C3/C4 OLEFINS= 32095.8
          CONVERSION Wt%= 78.3944     CONVERSION Vol %= 80
          COKE, WT% 9.56739
          COKE  ,0/HR 163973          Sulfur in Flue Gas,Lbs/hr= 501.012
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CAT POLY UNIT
*** FEED ***

< 10 > CAT POLY FEED= 1E-06
*** PRODUCT ***
< 15 > POLYMER= 4.08510E-07
< 16 > LE FROM POLY (FOE)= 3.12804E-07


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 29100
< 62 > C3/C4 TO ALKYL= 20095.4
< 20 > I-C4 FR. GAS PLANT= 6265.26
< 21 > I-C4 IMPORTED= 2739.39
*** PRODUCT ***
< 50 > ALKYLATE= 20810.4
< 63 > LE FROM ALKYL (FOE)= 2446.13


CATALYTIC REFORMER UNIT
  No. Name          BPCD        Lbs/hr        IBP         EBP         S.G.        API          SULFUR WT%  Lbs/hr Su
             *** FEED ***
 9   REFORMER FEED 62500       685700        169.937     321.673     .753242   56.3546          0            0
             *** PRODUCT ***
 17  REFORMATE     49983.1     586872                                .806028   44.0523          0            0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 11487.3
CONVERSION(LV%)= 79.973     Severity (RON Clear)= 98    FEED KW= 11.8537


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 54422.8
< 57 > LE FROM REFORMER (FOE)= 11487.3
< 18 > LE FROM CAT CRACKER (FOE)= 19188
< 16 > LE FROM POLY (FOE)= 3.12804E-07
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 29823.5
< 20 > I-C4 FR. GAS PLANT= 6265.26
< 49 > REF C4 TO BLENDING = 8900.89
< 69 > LSR= 40552.2


ISOMERIZATION UNIT (ONCE THRU)
*** FEED ***
< 69 > LSR= 40552.2
*** PRODUCT ***
< 29 > LSR+ISO= 40072.1


*** BY-PASS= 26 %   ***
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          GASOLINE BLENDING
          *** FEED ***
          < 29 > LSR+ISO= 40072.1
          < 26 > REFORMATE= 27402.1
          < 50 > ALKYLATE= 20810.4
          < 15 > POLYMER= 4.00518E-07
          < 14 > CRACKED GAS= 73525.6
          < 49 > REF C4 TO BLENDING = 8900.89
          < 68 > IMPORTED C4= 0
          *** PRODUCT ***
          < 22 > LEADED REGULAR= 51175
          < 23 > UNLEADED REGULAR= 104062
          < 24 > UNLEADED PREMIUM= 15348

          < 25 > AVIATION GASOLINE= 126


          *** GASOLINE COMPOSITION ***


                   LR          UR            UP          AV


LSR           .436674     .170334       0           0
CRACKED GAS   .519194     .4227         .193432     0
REFORMATE     0           .183746       .539553     0
POLYMER       0           3.92571E-12   0           0
ALKYLATE      0           .168884       .2028       .9786
C4            .0441315    .0543352      .0642154    .0214


          TURBO FUEL BLENDING
          *** FEED ***
          < 30 > LSR= 470.47
          < 58 > NAPHTHA= 4865.84
          < 59 > KEROSENE= 18565.7
          *** PRODUCT ***
          < 42 > JET FUEL B= 4277
          < 43 > JET FUEL A= 19625


          *** TURBO FUEL COMPOSITION ***


                         NAPHTHA BASE  KEROSENE BASE


          LSR            .11           0
          NAPHTHA        .61           .115
          KEROSENE       .28           .885


          DISTILLATE BLENDING
          *** FEED ***
          < 60 > KEROSENE= 89896.1
          < 40 > LGO= 17530.8
          < 38 > LCO= 15039.1
          *** PRODUCT ***
          < 44 > STOVE OIL= 2264
          < 45 > LIGHT FUEL OIL= 38243
          < 46 > DIESEL FUEL= 81959
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*** DISTILLATE COMPOSITION ***


              STOVE OIL    DIESEL FUEL   LFO


KEROSENE      1            .8            .576966
LCO           0            .1            .178939
LGO           0            .1            .244095

HEAVY FUEL OIL BLENDING
*** FEED ***
< 41 > LGO= 125.402
< 35 > LCO= 5555
< 13 > HCO= 5148.52
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 22445.1
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 33274




             OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 22581
< 36 > HVGO TO LUBE OIL= 10892
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 8366
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285
< 67 > VGO PETROCHEMICAL FEED= 15285

DISTILLATE DESULFURIZATION


     STREAM            TOTAL            FEED  TO  DDS                                FINAL STREAM
                        BPCD       BPCD     Lbs/hr       SULFUR WT%      % BYPASS    SULFUR WT%
     KEROSENE          100462      100462   1.31717E+06  .106901         0           5.35049E-03
     LGO               17656.2     17656.2  227160       .312237         0           .0313117
     LCO               20594.1     18534.7  260376       .948254         9.99995     .181562
     HCO               5148.52     0        0            1.49824         100         1.49824
     VAC RESIDUUM      22445.1     0        0            2.62443         100         2.62443
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***PRODUCT SLATES & SPECIFICATIONS***

                  JET FUEL B   JET FUEL A    STOVE OIL     LFO           DIESEL FUEL   HFO
               ______________________________________________________________________________

               BPCD            4277         19625         2264          38243         81959         33274
               S.G.            .766424      .824419       .833667       .869149       .851692       1.04433
               ASTM 10%        206.573      345.131       384.722       402.487       391.887
               ASTM 20%        223.878      368.622       399.599       432.863       412.698
               ASTM 50%        273.467      432.714       448.178       500.005       472.688
               ASTM 90%        468.255      516.968       519.576       606.922       569.938
               RVP,psia        2.80531
               Sulfur Wt %     .021255      7.60434E-03   5.34503E-03   .0464743      .027824       2.05959
               Flash Point,F   64.3088      133.86        144.567       154.126       140.333
               Pour Point,F   -95.7316     -50.1785      -44.6169      -38.925       -44.1401
               Cetane No.                                                            40.7088
               Visc @100F,cs   .773153      1.6177        1.82832       2.6398        2.14338       1955.18
               Visc @122F,cs   .682057      1.37922       1.54805       2.17952       1.79522       676.041
               Watsons K       11.8229      11.6397       11.5966       11.3369       11.4482       10.7746
               MeABP           284.006      423.628       443.583       496.69        466.965       964.79


GASOLINE


               LEADED REGULAR,BPCD            51175
               TEL Addition,cc/IG: 1.24
               RON / MON / (R+M)/2 (Clear)    89.0475 / 81.865 / 85.4563
               RON / MON / (R+M)/2            93.8752 / 86.1039 / 89.9896
               RVP,psia                       12.477



               MMT Addition,mg/l: 0
               UNLEADED REGULAR,BPCD          104062
               RON / MON / (R+M)/2            92.8307 / 85.2063 / 89.0185
               RVP,psia                       10.8306


               UNLEADED PREMIUM,BPCD          15348
               RON / MON / (R+M)/2            95.9999 / 87.5832 / 91.7916
               RVP,psia                       9.76459


               AVIATION GASOLINE,BPCD         126
               RON / MON / (R+M)/2            93 / 90.8 / 91.9
               RVP,psia                       10
```

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                              STREAMS

< 0 > CRUDE FEED= 440003                          < 1 > REDUCED CRUDE= 155057
< 2 > OVERHEAD= 54422.8                           < 3 > NAPHTHA= 82650.8
< 4 > KEROSENE= 108462                            < 5 > LGO= 48289.9
< 6 > HVGO= 124246                                < 7 > RESIDUUM= 30811.1
< 8 > FCCU FEED= 128713                           < 9 > REFORMER FEED= 62500
< 10 > CAT POLY FEED= 1E-06                       < 11 > ALKYLATION FEED= 29100
< 12 > LCO= 20594.1                               < 13 > HCO= 5148.52
< 14 > CRACKED GAS= 73525.6                       < 15 > POLYMER= 4.00518E-07
< 16 > LE FROM POLY (FOE)= 3.12884E-07            < 17 > REFORMATE= 49993.1
< 18 > LE FROM CAT CRACKER (FOE)= 19180           < 19 > FUEL GAS (FOE)= 29823.5
< 20 > I-C4 FR. GAS PLANT= 6265.26                < 21 > I-C4 IMPORTED= 2739.39
< 22 > LEADED REGULAR= 51175                      < 23 > UNLEADED REGULAR= 104062
< 24 > UNLEADED PREMIUM= 15348                    < 25 > AVIATION GASOLINE= 126
< 26 > REFORMATE= 27402.1                         < 27 > NAPHTHA SPECIALTIES= 22581
< 28 > LSR= 41022.7                               < 29 > LSR+ISO= 40072.1
< 30 > LSR= 470.47                                < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 155057                      < 33 > VAC RESID TO ASPHALT PLANT= 8366
< 34 > VAC RESIDUUM= 22445.1                      < 35 > LCO= 5555
< 36 > HVGO TO LUBE OIL= 10082                    < 37 > HVGO= 0
< 38 > LCO= 15039.1                               < 39 > C3/C4 -FCCU= 20095.4
< 40 > LGO= 17530.8                               < 41 > LGO= 125.402
< 42 > JET FUEL B= 4277                           < 43 > JET FUEL A= 19625
< 44 > STOVE OIL= 2264                            < 45 > LIGHT FUEL OIL= 38243
< 46 > DIESEL FUEL= 81959                         < 47 > HEAVY FUEL OIL= 33274
< 48 > RESID TO COKING= 0                         < 49 > REF C4 TO BLENDING = 8900.69
< 50 > ALKYLATE= 20810.4                          < 51 > CRUDE LIGHT ENDS= 2.98522
< 52 > TOTAL PRODUCT= 422752                      < 53 > C2 % IN CRUDE FEED= .00668
< 54 > C3 % IN CRUDE FEED= .69156                 < 55 > I-C4 % IN CRUDE FEED= .36344
< 56 > N-C4 % IN CRUDE FEED= 1.04354              < 57 > LE FROM REFORMER (FOE)= 11487.3
< 58 > NAPHTHA= 4865.84                           < 59 > KEROSENE= 18565.7
< 60 > KEROSENE= 89896.1                          < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 20095.4                    < 63 > LE FROM ALKYL (FOE)= 2446.13
< 64 > HVGO= 98079.3                              < 65 > LGO = 30633.7
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285          < 67 > VGO PETROCHEMICAL FEED= 15285
< 68 > IMPORTED C4= 0                             < 69 > LSR= 40552.2
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                              LIGHT ENDS BALANCE




                                   *** FROM ***
               CRUDE UNIT    REFORMER      CAT CRACKER   POLY          ALKYL        ISO          TOTAL
C2  ,#/HR      2040.4        8868.59       36713.5       0             0            0            47622.5
C3  ,#/HR      22971.8       23579.1       27917.1       0             14682.4      1110.32      90260.7
IC4  ,#/HR     13426.6       14288.9       65755.6       0             0            1975.77      95446.9
NC4  ,#/HR     70522.4       20853.2       24674         0             15448.5      5626.02      137124
H2  ,#/HR      0             22449.7       14941.5       0             0            0            37391.2
C1  ,#/HR      0             8868.59       15222.7       0             0            0            24091.3
H2S  ,#/HR     0             0             4779.19       0             0            0            4779.19
C2=  ,#/HR     0             0             22386.3       0             0            0            22386.3
C3=  ,#/HR     0             0             66183.4       0             0            0            66183.4
C4=  ,#/HR     0             0             97965.1       0             0            0            97965.1
TOTAL  ,#/HR   108961        98908.1       376538        3.87649E-06   30130.9      8712.11      623251
BPCD (FOE)     8810.76       11487.3       32267.9       3.12884E-07   2446.12      702.685      55714.8


                                   *** TO ***
               POLY          ALKY          GAS BLEND     PC FEED       DDS          FUEL GAS     TOTAL
C2  ,#/HR      0             0             0             0             0            47622.5      47622.5
C3  ,#/HR      0             14682.4       0             0             0            75578.3      90260.7
IC4  ,#/HR     0             92733.1       1284.52       0             0            1429.23      95446.9
NC4  ,#/HR     0             15448.6       57591.5       0             0            64084.1      137124
H2  ,#/HR      0             0             0             0             10838        26553.2      37391.2
C1  ,#/HR      0             0             0             0             0            24091.3      24091.3
H2S  ,#/HR     0             0             0             0             0            4779.19      4779.19
C2=  ,#/HR     0             0             0             0             0            22386.3      22386.3
C3=  ,#/HR     0             32321.6       0             0             0            33861.8      66183.4
C4=  ,#/HR     0             61336.6       17337.1       0             0            19291.4      97965.1
TOTAL  ,#/HR   8.2000E-06    216522        76213.1       0             10838        319677       623251
BPCD (FOE)     6.54099E-07   17285.4       6104.45       0             2501.41      29823.5      55714.8
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                        **** OVERALL MASS BALANCE ****
*** FEED ***


                        BPCD                      #/HR


CRUDE                    448883                    5.49906E+06
BUTANE                   2739.39                   22545.2
TOTAL                    451622                    5.52161E+06




*** PRODUCT ***


FUEL GAS (FOE)                29823.5                   319677
MOTOR GASOLINE                170711                    1.79565E+06
AVIATION TURBO FUELS          23902                     283433
DISTILLATES                   122466                    1.52852E+06
HEAVY FUEL OIL                33274                     506189
OTHER PRODUCTS                72399                     913584
H2 TO DESULFURIZERS (FOE)     2501.41                   10838
COKE (FOE)                    8733.2                    163973
TOTAL                         463810                    5.52186E+06
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TIME:08.49.03 DATE:WEDJUN201984172 62
REFINERY SIMULATION PROGRAM

CASE:ONTBAS21 REGION:ONTARIO

**** FEED BLEND ****

          CRUDE ORIGIN            LV %          BPCD

           CANDNL                 49            219204
           CANDNH                 9.2           41156.6
           SYNCRUDE               30.8          137785
           CONDENSA               11            49209
             No.  MBP        LV %       S.G.        API         SULFUR WT%  BPCD         Lbs/hr FEED    Lbs/hr SULFUR
             Total           100                                            447354       5.48034E+06    26434.1
             Average                    .84098      36.7562     .482344

                **** MATERIAL BALANCE ****


           CRUDE UNIT
             No. Name            BPCD        Lbs/hr       IBP         EBP         S.G.        API          SULFUR WT%  Lbs/hr Su
                         *** FEED ***
            0   CRUDE FEED     447354      5.48034E+06  60          1300        .840981   36.7559        .482344      26434.1
                         *** PRODUCT ***
            2   OVERHEAD       54104.9     505276       60          169.671     .641094   89.2166        .0289442     146.248
            28  LSR            40750.4     396654       60          169.671     .668205   80.2614        .0368478     146.158
            3   NAPHTHA        82150.8     901149       169.671     320.999     .753034   56.4065        .0268073     241.574
            4   KEROSENE       108444      1.31671E+06  320.999     560         .833519   38.2622        .106685      1404.74
            5   LGO            48125.5     619169       560         660         .88321    28.711         .312237      1933.28
            1   REDUCED CRUDE 154529       2.13803E+06  660         1300        .949805   17.478         1.06211      22708.3


           VACUUM UNIT
             No. Name            BPCD        Lbs/hr       IBP         EBP         S.G.        API          SULFUR WT%  Lbs/hr Su
                         *** FEED ***
            32  REDUCED CRUDE 154529       2.13803E+06  660         1300        .949805   17.478         1.06211      22708.3
                         *** PRODUCT ***
            6   HVGO           123825      1.66507E+06  660         1050        .923111   21.786         .618341      10295.8
            7   RESIDUUM       30704.2     472968       1050        1300        1.05746   2.31122        2.62443      12412.7


           CAT CRACKER
             No. Name            BPCD        Lbs/hr       IBP         EBP         S.G.        API          SULFUR WT%  Lbs/hr Su
                         *** FEED ***
            65  LGO            30166.7     388116       560         660         .88321    28.711         .312237      1211.84
            64  HVGO           97658.3     1.31321E+06  660         1050        .923111   21.786         .618341      8120.1
                         *** TOTAL FEED ***
            8   FCCU FEED      127825      1.70132E+06  560         1050        .913694   23.3658        .548511      9331.94
                         *** PRODUCT ***
            12  LCO            20452       207353       430         650         .964518   15.2054        .949253      2727.71
            13  HCO            5113        88243.7      650         736.426     1.07737   -.161636       1.49982      1203.51
            14  CRACKED GAS    72994.8     796000                               .749437   57.3084        .0538959     429.49
            39  C3/C4 -FCCU    20096.3     164969                               .56353    119.596        0            0
           *** PRODUCT ***
           < 18 > LE FROM CAT CRACKER (FOE)= 10970
           AVAILABLE C3/C4 OLEFINS= 31869.9
           CONVERSION Wt%= 78.3935    CONVERSION Vol %= 80
           COKE, WT% 9.58333
           COKE  ,0/HR 163127         Sulfur in Flue Gas,Lbs/hr= 490.938
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CAT POLY UNIT
*** FEED ***




< 10 > CAT POLY FEED= 1E-06
*** PRODUCT ***
< 15 > POLYMER= 4.08505E-07
< 16 > LE FROM POLY (FOE)= 3.12905E-07


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 29101.3
< 62 > C3/C4 TO ALKYL= 20096.3
< 20 > I-C4 FR. GAS PLANT= 6054.18
< 21 > I-C4 IMPORTED= 2930.81
*** PRODUCT ***
< 50 > ALKYLATE= 20810.5
< 63 > LE FROM ALKYL (FOE)= 2447.11


CATALYTIC REFORMER UNIT
 No. Name          BPCD      Lbs/hr      IBP        EBP        S.G.      API        SULFUR WT%  Lbs/hr Su
            *** FEED ***
 9  REFORMER FEED 62000     600106      169.671    320.999   .753034   56.4065     0           0
            *** PRODUCT ***
 17  REFORMATE    50681.5   591459                           .801134   45.1247     0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 10212.8
CONVERSION(LV%)= 81.7444    Severity (RON Clear)= 96.5  FEED KW= 11.8546


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 34104.9
< 57 > LE FROM REFORMER (FOE)= 10212.8
< 18 > LE FROM CAT CRACKER (FOE)= 18970
< 16 > LE FROM POLY (FOE)= 3.12905E-07
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 20292.2
< 20 > I-C4 FR. GAS PLANT= 6054.18
< 49 > REF C4 TO BLENDING = 8911.99
< 69 > LSR= 40279.9


ISOMERIZATION UNIT (ONCE THRU)
*** FEED ***
< 69 > LSR= 40279.9
*** PRODUCT ***
< 29 > LSR+ISO= 39893.2


*** BY-PASS= 40 %   ***
```

```
     GASOLINE BLENDING
     *** FEED ***
     < 29 > LSR+ISO= 39893.2
     < 26 > REFORMATE= 28100.5
     < 50 > ALKYLATE= 20810.5
     < 15 > POLYMER= 4.08505E-07
     < 14 > CRACKED GAS= 72994.8
     < 49 > REF C4 TO BLENDING = 8911.99
     < 68 > IMPORTED C4= 0
     *** PRODUCT ***
     < 22 > LEADED REGULAR= 17058
     < 23 > UNLEADED REGULAR= 138179
     < 24 > UNLEADED PREMIUM= 15348




     < 25 > AVIATION GASOLINE= 126


     *** GASOLINE COMPOSITION ***


                LR          UR          UP          AV


LSR         .379995     .241797     0           0
CRACKED GAS .571433     .43         .249564     0
REFORMATE   0           .15045      .476381     0
POLYMER     0           2.95634E-12 0           0
ALKYLATE    0           .126387     .21         .9786
C4          .0485718    .0513659    .0640553    .0214


     TURBO FUEL BLENDING
     *** FEED ***
     < 30 > LSR= 470.47
     < 58 > NAPHTHA= 4865.84
     < 59 > KEROSENE= 18565.7
     *** PRODUCT ***
     < 42 > JET FUEL B= 4277
     < 43 > JET FUEL A= 19625


     *** TURBO FUEL COMPOSITION ***


                  NAPHTHA BASE  KEROSENE BASE


     LSR          .11           0
     NAPHTHA      .61           .115
     KEROSENE     .28           .885
```

```
DISTILLATE BLENDING
*** FEED ***
< 60 > KEROSENE= 89878.1
< 40 > LGO= 17002
< 30 > LCO= 14706
*** PRODUCT ***
< 44 > STOVE OIL= 2264
< 45 > LIGHT FUEL OIL= 38243
< 46 > DIESEL FUEL= 81959


*** DISTILLATE COMPOSITION ***


                 STOVE OIL     DIESEL FUEL   LFO


KEROSENE          1             .7             .790804
LCO               0             .1             .172322
LGO               0             .2             .0368739


HEAVY FUEL OIL BLENDING
*** FEED ***
< 41 > LGO= 156.828
< 35 > LCO= 5666
< 13 > HCO= 5113
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 22338.2
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 33274




                 OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 22501
< 36 > HVGO TO LUBE OIL= 10002
< 40 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 8366
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285
< 67 > VGO PETROCHEMICAL FEED= 15285

DISTILLATE DESULFURIZATION


     STREAM           TOTAL                  FEED  TO  DDS                                          FINAL STREAM
                       BPCD           BPCD        Lbs/hr      SULFUR WT%              % BYPASS      SULFUR WT%
     KEROSENE         100444          100444      1.31671E+06  .106685                0             5.33966E-03
     LGO              17958.0         17958.0     231053       .312237                0             .0313117
     LCO              20452           18406.8     250610       .949253                10            .101756
     HCO              5113            0           0            1.49982                100           1.49982
     VAC RESIDUUM     22338.2         0           0            2.62443                100           2.62443
```

```
***PRODUCT SLATES & SPECIFICATIONS***


                   JET FUEL B    JET FUEL A    STOVE OIL     LFO           DIESEL FUEL   HFO
_______________________________________________________________________________________________

BPCD               4277          19625         2264          38243         81959         33274
S.G.               .766239       .824263       .833519       .857925       .856557       1.04387
ASTM 10%           206.4         344.538       384.031       391.458       395.328
ASTM 20%           223.604       368.009       398.975       412.733       420.458
ASTM 50%           272.98        432.28        447.782       470.686       489.531
ASTM 90%           467.934       516.901       519.505       547.623       599.329
RVP,psia           2.74264
Sulfur Wt %        .0212301      7.59024E-03   5.33423E-03   .0402247      .0303816      2.05110
Flash Point,F      64.215        133.529       144.199       148.109       150.195
Pour Point,F      -95.841       -50.3346      -44.7752      -52.6559      -37.9934
Cetane No.                                                                 41.5134
Visc @100F,cs      .771726       1.61362       1.82358       2.101         2.3679        1046.55
Visc @122F,cs      .600849       1.37593       1.54427       1.75914       1.97162       645.218
Watsons K          11.8236       11.64         11.5968       11.346        11.4454       10.774
MeABP              283.616       423.199       443.16        462.321       482.252       962.67


GASOLINE


          LEADED REGULAR,BPCD           17058
          TEL Addition,cc/IG: 1.24
          RON / MON / (R+M)/2 (Clear)   89.2106 / 81.4978 / 85.3542
          RON / MON / (R+M)/2           93.9873 / 85.6665 / 89.8269
          RVP,psia                      11.9474


          MMT Addition,mg/l: 18
          UNLEADED REGULAR,BPCD         138179
          RON / MON / (R+M)/2           93.1016 / 84.8249 / 88.9633
          RVP,psia                      11.1446


          UNLEADED PREMIUM,BPCD         15348
          RON / MON / (R+M)/2           96.1999 / 87.3995 / 91.7997
          RVP,psia                      9.77122




          AVIATION GASOLINE,BPCD        126
          RON / MON / (R+M)/2           93 / 90.8 / 91.9
          RVP,psia                      10
```

STREAMS

```
< 0 > CRUDE FEED= 447354                    < 1 > REDUCED CRUDE= 154529
< 2 > OVERHEAD= 54104.9                     < 3 > NAPHTHA= 82150.8
< 4 > KEROSENE= 108444                      < 5 > LGO= 40125.5
< 6 > HVGO= 123825                          < 7 > RESIDUUM= 30704.2
< 8 > FCCU FEED= 127825                     < 9 > REFORMER FEED= 62000
< 10 > CAT POLY FEED= 1E-06                 < 11 > ALKYLATION FEED= 29101.3
< 12 > LCO= 20452                           < 13 > HCO= 5113
< 14 > CRACKED GAS= 72994.8                 < 15 > POLYMER= 4.08505E-07
< 16 > LE FROM POLY (FOE)= 3.12905E-07      < 17 > REFORMATE= 50681.5
< 18 > LE FROM CAT CRACKER (FOE)= 10970     < 19 > FUEL GAS (FOE)= 28292.2
< 20 > I-C4 FR. GAS PLANT= 6054.18          < 21 > I-C4 IMPORTED= 2950.81
< 22 > LEADED REGULAR= 17050                < 23 > UNLEADED REGULAR= 138179
< 24 > UNLEADED PREMIUM= 15348              < 25 > AVIATION GASOLINE= 126
< 26 > REFORMATE= 28100.5                   < 27 > NAPHTHA SPECIALTIES= 22581
< 28 > LSR= 40750.4                         < 29 > LSR+ISO= 39893.2
< 30 > LSR= 470.47                          < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 154529                < 33 > VAC RESID TO ASPHALT PLANT= 8366
< 34 > VAC RESIDUUM= 22338.2                < 35 > LCO= 5666
< 36 > HVGO TO LUBE OIL= 10882              < 37 > HVGO= 0
< 38 > LCO= 14786                           < 39 > C3/C4 -FCCU= 20096.3
< 40 > LGO= 17002                           < 41 > LGO= 156.828
< 42 > JET FUEL B= 4277                     < 43 > JET FUEL A= 19625
< 44 > STOVE OIL= 2264                      < 45 > LIGHT FUEL OIL= 38243
< 46 > DIESEL FUEL= 81959                   < 47 > HEAVY FUEL OIL= 33274
< 48 > RESID TO COKING= 0                   < 49 > REF C4 TO BLENDING = 8911.99
< 50 > ALKYLATE= 20810.5                    < 51 > CRUDE LIGHT ENDS= 2.98522
< 52 > TOTAL PRODUCT= 422752                < 53 > C2 % IN CRUDE FEED= .00668
< 54 > C3 % IN CRUDE FEED= .69156           < 55 > I-C4 % IN CRUDE FEED= .36344
< 56 > N-C4 % IN CRUDE FEED= 1.04354        < 57 > LE FROM REFORMER (FOE)= 10212.8
< 58 > NAPHTHA= 4865.84                     < 59 > KEROSENE= 18565.7
< 60 > KEROSENE= 89878.1                    < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 20096.3              < 63 > LE FROM ALKYL (FOE)= 2447.11
< 64 > HVGO= 97658.3                        < 65 > LGO = 30166.7
< 66 > NAPHTHA PETROCHEMICAL FEED= 15285    < 67 > VGO PETROCHEMICAL FEED= 15285
< 68 > IMPORTED C4= 0                       < 69 > LSR= 40279.9
```

```
                                LIGHT ENDS BALANCE




                                 *** FROM ***
              CRUDE UNIT   REFORMER    CAT CRACKER  POLY         ALKYL      ISO        TOTAL
C2  ,#/HR      2033.45      7650.11     36494.7     0            0          0          46178.3
C3  ,#/HR      22893.6      20892.6     27724.5     0            14685.1    894.214    87090
IC4  ,#/HR     13380.9      13358.4     65284.2     0            0          1591.22    93614.7
NC4  ,#/HR     70282.3      19495.2     24514.1     0            15457.9    4531.01    134281
H2  ,#/HR      0            19600.1     14852.4     0            0          0          34452.5
C1  ,#/HR      0            7650.11     15131.9     0            0          0          22782
H2S  ,#/HR     0            0           4751.81     0            0          0          4751.81
C2=  ,#/HR     0            0           22252.9     0            0          0          22252.9
C3=  ,#/HR     0            0           65681.1     0            0          0          65681.1
C4=  ,#/HR     0            0           97300.2     0            0          0          97300.2
TOTAL  ,#/HR   108590       88646.5     373988      3.87675E-06  30143      7016.44    608384
BPCD (FOE)     8780.77      10212.8     32051.1     3.12986E-07  2447.1     565.919    54057.7


                                 *** TO ***
              POLY         ALKY        GAS BLEND    PC FEED      DDS        FUEL GAS   TOTAL
C2  ,#/HR      0            0           0            0            0          46178.3    46178.3
C3  ,#/HR      0            14685.2     0            0            0          72404.9    87090
IC4  ,#/HR     0            90992.6     1271.47      0            0          1350.88    93614.7
NC4  ,#/HR     0            15457.9     57610.8      0            0          61211.8    134281
H2  ,#/HR      0            0           0            0            10861      23591.5    34452.5
C1  ,#/HR      0            0           0            0            0          22782      22782
H2S  ,#/HR     0            0           0            0            0          4751.81    4751.81
C2=  ,#/HR     0            0           0            0            0          22252.9    22252.9
C3=  ,#/HR     0            32305       0            0            0          33376.1    65681.1
C4=  ,#/HR     0            61354.9     17428        0            0          18517.3    97300.2
TOTAL  ,#/HR   8.20895E-06  214795      76310.3      0            10861      306417     608384
BPCD (FOE)     6.5411E-07   17146.7     6112.1       0            2506.71    28292.2    54057.7
```

```
                              **** OVERALL MASS BALANCE ****
*** FEED ***


                              BPCD                   #/HR


CRUDE                          447354                 5.48034E+06
BUTANE                         2950.81                24285.2
TOTAL                          450305                 5.50463E+06




*** PRODUCT ***


FUEL GAS (FOE)                 28292.2                306417
MOTOR GASOLINE                 170711                 1.79513E+06
AVIATION TURBO FUELS           23902                  283377
DISTILLATES                    122466                 1.52807E+06
HEAVY FUEL OIL                 33274                  505966
OTHER PRODUCTS                 72399                  911928
H2 TO DESULFURIZERS (FOE)      2506.71                10861
COKE (FOE)                     8688.14                163127
TOTAL                          462239                 5.50487E+06
```

```
TIME:01.17.58 DATE:TUEJUN 51984157 61
REFINERY SIMULATION PROGRAM

CASE:WESBAS20 REGION:WESTERN

#### FEED BLEND ####

          CRUDE ORIGIN            LV %          BPCD

           CANDNL                 65.1          322977
           SYNCRUDE               31.5          156279
           CONDENSA               3.4           16868.2
             No.  MBP        LV %        S.G.       API          SULFUR WT%  BPCD          Lbs/hr FEED      Lbs/hr SULFUR
             Total           100                                             496125        6.10068E+06      18985.4
             Average                  .844145     36.1252       .311201

                #### MATERIAL BALANCE ####


           CRUDE UNIT
             No. Name         BPCD        Lbs/hr        IBP         EBP         S.G.        API          SULFUR WT%  Lbs/hr S
                          ### FEED ###
            0   CRUDE FEED    496124      6.10068E+06   60          1240        .844147     36.1249      .311201     18985.4
                          ### PRODUCT ###
            2   OVERHEAD      49358.2     457533        60          170.082     .636346     90.8635      .0147232    67.3633
            28  LSR           33837.2     332355        60          170.082     .674275     78.355       .0202679    67.3613
            3   NAPHTHA       85501.1     941604        170.082     320.151     .756008     55.6674      .014829     139.63
            4   KEROSENE      129566      1.57161E+06   320.151     560         .832693     38.4306      .0620516    975.212
            5   LGO           56593.9     726285        560         660         .880983     29.116       .219173     1591.82
            1   REDUCED CRUDE 175106      2.40364E+06   660         1240        .942321     18.6611      .67445      16211.4


           VACUUM UNIT
             No. Name         BPCD        Lbs/hr        IBP         EBP         S.G.        API          SULFUR WT%  Lbs/hr S
                          ### FEED ###
            32  REDUCED CRUDE 175106      2.40364E+06   660         1240        .942321     18.6611      .67445      16211.4
                          ### PRODUCT ###
            6   HVGO          143362      1.91986E+06   660         1050        .919318     22.4184      .412657     7922.44
            7   RESIDUUM      31744       483783        1050        1240        1.04621     3.75011      1.7133      8288.65


           CAT CRACKER
             No. Name         BPCD        Lbs/hr        IBP         EBP         S.G.        API          SULFUR WT%  Lbs/hr S
                          ### FEED ###
            65  LGO           11990.4     153876        560         660         .880983     29.116       .219173     337.255
            64  HVGO          137890      1.84658E+06   660         1050        .919318     22.4184      .412657     7620.05
                          ### TOTAL FEED ###
            8   FCCU FEED     149880      2.00045E+06   560         1050        .916251     22.9337      .397775     7957.31
                          ### PRODUCT ###
            12  LCO           26019.2     366513        430         650         .966998     14.8292      .648417     2376.53
            13  HCO           6504.79     101856        650         743.652     1.07494     .135254      1.0245      1043.52
            14  CRACKED GAS   83438.1     910133                                .748808     57.467       .0411306    374.343
            39  C3/C4 -FCCU   35715.3     293317                                .563784     119.483      0           0
           ### PRODUCT ###
           < 18 > LE FROM CAT CRACKER (FOE)= 13376.5
           AVAILABLE C3/C4 OLEFINS= 36159.9
           CONVERSION Wt%= 76.5869     CONVERSION Vol %= 78.3
           COKE, WT% 9.81573
           COKE  ,0/HR 196460          Sulfur in Flue Gas,Lbs/hr= 411.674
```

```
CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 15000

*** PRODUCT ***
< 15 > POLYMER= 6122.88
< 16 > LE FROM POLY (FOE)= 4702.11


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 30000
< 62 > C3/C4 TO ALKYL= 20715.3
< 20 > I-C4 FR. GAS PLANT= 7796.22
< 21 > I-C4 IMPORTED= 1488.53
*** PRODUCT ***
< 50 > ALKYLATE= 21428.3
< 63 > LE FROM ALKYL (FOE)= 2548.97


CATALYTIC REFORMER UNIT
  No. Name          BPCD        Lbs/hr        IBP        EBP        S.G.        API          SULFUR WT%  Lbs/hr S
               *** FEED ***
 9   REFORMER FEED 70750        779153        170.082    320.151    .756008   55.6674       0              0
               *** PRODUCT ***
 17  REFORMATE     56077        662667                              .811223   42.928        0              0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 13575.5
CONVERSION(LV%)= 79.2608    Severity (RON Clear)= 99    FEED KW= 11.8164


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 49358.2
< 57 > LE FROM REFORMER (FOE)= 13575.5
< 18 > LE FROM CAT CRACKER (FOE)= 13376.5
< 16 > LE FROM POLY (FOE)= 4702.11
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 27300.7
< 20 > I-C4 FR. GAS PLANT= 7796.22
< 49 > REF C4 TO BLENDING = 12023.4
< 69 > LSR= 31122.4


ISOMERIZATION UNIT (ONCE THRU)
*** FEED ***
< 69 > LSR= 31122.4
*** PRODUCT ***
< 29 > LSR+ISO= 31122.4


*** BY-PASS= 100 %   ***
```

```
GASOLINE BLENDING
*** FEED ***
< 29 > LSR+ISO= 31122.4
< 26 > REFORMATE= 49095
< 50 > ALKYLATE= 21428.3
< 15 > POLYMER= 6122.88
< 14 > CRACKED GAS= 83438.1
< 49 > REF C4 TO BLENDING = 12023.4
< 68 > IMPORTED C4= 0
*** PRODUCT ***
< 22 > LEADED REGULAR= 60195
< 23 > UNLEADED REGULAR= 126555
< 24 > UNLEADED PREMIUM= 13901
< 25 > AVIATION GASOLINE= 2579
```

```
*** GASOLINE COMPOSITION ***


              LR         UR          UP          AV


LSR           .214887    .143711     0           0
CRACKED GAS   .71002     .29         .287564     0
REFORMATE     .013643    .33331      .438222     0
POLYMER       0          .0483811    0           0
ALKYLATE      0          .126302     .21         .9786
C4            .06145     .0582967    .0642135    .0214
```

```
TURBO FUEL BLENDING
*** FEED ***
< 30 > LSR= 2714.79
< 58 > NAPHTHA= 14374
< 59 > KEROSENE= 20983.2
*** PRODUCT ***
< 42 > JET FUEL B= 20883
< 43 > JET FUEL A= 17109
```

```
*** TURBO FUEL COMPOSITION ***


                NAPHTHA BASE  KEROSENE BASE


LSR             .13           0
NAPHTHA         .59           .12
KEROSENE        .28           .88
```

```
DISTILLATE BLENDING
*** FEED ***
< 60 > KEROSENE= 108662
< 40 > LGO= 44245.3
< 38 > LCO= 24219.2
*** PRODUCT ***
< 44 > STOVE OIL= 5913
< 45 > LIGHT FUEL OIL= 13398
< 46 > DIESEL FUEL= 157816


*** DISTILLATE COMPOSITION ***


               STOVE OIL     DIESEL FUEL   LFO


KEROSENE        1             .63           .248203
LCO             0             .1            .629763
LGO             0             .27           .122035

HEAVY FUEL OIL BLENDING
*** FEED ***
< 41 > LGO= 358.178
< 35 > LCO= 1800
< 13 > HCO= 6504.79
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 15679
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 24342




             OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 6982
< 36 > HVGO TO LUBE OIL= 5472
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 16065
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 377
< 67 > VGO PETROCHEMICAL FEED= 0

DISTILLATE DESULFURIZATION


      STREAM           TOTAL               FEED  TO  DDS                                       FINAL STRE
                        BPCD      BPCD      Lbs/hr      SULFUR WT%              % BYPASS       SULFUR WT%
      KEROSENE    :    129566    129566    1.57161E+06  .0620516                  0           3.10441E-0
      LGO              44603.5   44603.5   572409       .219173                   0           .0219606
      LCO              26019.2   13009.6   183257       .640417                   50          .357673
      HCO              6504.79   0         0            1.0245                    100         1.0245
      VAC RESIDUUM     15679     0         0            1.7133                    100         1.7133
```

```
***PRODUCT SLATES & SPECIFICATIONS***

                    JET FUEL B    JET FUEL A    STOVE OIL     LFO           DIESEL FUEL   HFO
                 ____________________________________________________________________________

BPCD                20883         17109         5913          13398         157816        24342
S.G.                .766054       .823491       .832693       .923166       .859162       1.04559
ASTM 10%            198.051       339.391       384.638       458.664       399.209
ASTM 20%            218.04        365.061       399.164       477.406       427.011
ASTM 50%            272.828       430.592       446.043       530.622       503.754
ASTM 90%            467.306       516.734       519.432       607.25        607.405
RVP,psia            2.58136
Sulfur Wt %         .0110854      4.39444E-03   3.10258E-03   .238502       .0481014      1.41032
Flash Point,F       59.5294       130.673       144.53        185.138       152.324
Pour Point,F        -98.4946      -51.0597      -44.1994      -67.2957      -33.0154
Cetane No.                                                                  42.7199
Visc @100F,cs       .761928       1.59415       1.82011       3.49346       2.5412        1004.67
Visc @122F,cs       .672455       1.3602        1.54168       2.7966        2.10725       630.48
Watsons K           11.7988       11.6419       11.6076       10.7782       11.454        10.7511
MeABP               208.728       421.145       442.989       525.107       493.005       960.62


GASOLINE


          LEADED REGULAR,BPCD               60195
          TEL Addition,cc/IG: 1.24
          RON / MON / (R+M)/2 (Clear)       90.1453 / 81.1836 / 85.6645
          RON / MON / (R+M)/2               94.7716 / 85.1769 / 89.9743
          RVP,psia                          10.3302


          MMT Addition,mg/l: 0
          UNLEADED REGULAR,BPCD             126555
          RON / MON / (R+M)/2               93.25 / 84.8549 / 89.0525
          RVP,psia                          10.1255


          UNLEADED PREMIUM,BPCD             13901
          RON / MON / (R+M)/2               96.0298 / 87.5878 / 91.8088
          RVP,psia                          9.76203




          AVIATION GASOLINE,BPCD            2579
          RON / MON / (R+M)/2               93 / 90.8 / 91.9
          RVP,psia                          10
```

STREAMS

```
< 0 > CRUDE FEED= 496124                          < 1 > REDUCED CRUDE= 175106
< 2 > OVERHEAD= 49350.2                           < 3 > NAPHTHA= 85501.1
< 4 > KEROSENE= 129566                            < 5 > LGO= 56593.9
< 6 > HVGO= 143362                                < 7 > RESIDUUM= 31744
< 8 > FCCU FEED= 149000                           < 9 > REFORMER FEED= 70750
< 10 > CAT POLY FEED= 15000                       < 11 > ALKYLATION FEED= 30000
< 12 > LCO= 26019.2                               < 13 > HCO= 6504.79
< 14 > CRACKED GAS= 83438.1                       < 15 > POLYMER= 6122.08
< 16 > LE FROM POLY (FOE)= 4702.11                < 17 > REFORMATE= 56077
< 18 > LE FROM CAT CRACKER (FOE)= 13376.5         < 19 > FUEL GAS (FOE)= 27300.7
< 20 > I-C4 FR. GAS PLANT= 7796.22                < 21 > I-C4 IMPORTED= 1400.53
< 22 > LEADED REGULAR= 60195                      < 23 > UNLEADED REGULAR= 126555
< 24 > UNLEADED PREMIUM= 13901                    < 25 > AVIATION GASOLINE= 2579
< 26 > REFORMATE= 49095                           < 27 > NAPHTHA SPECIALTIES= 6982
< 28 > LSR= 33837.2                               < 29 > LSR+ISO= 31122.4
< 30 > LSR= 2714.79                               < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 175106                      < 33 > VAC RESID TO ASPHALT PLANT= 16065
< 34 > VAC RESIDUUM= 15679                        < 35 > LCO= 1000
< 36 > HVGO TO LUBE OIL= 5472                     < 37 > HVGO= 0
< 38 > LCO= 24219.2                               < 39 > C3/C4 -FCCU= 35715.3
< 40 > LGO= 44245.3                               < 41 > LGO= 350.178
< 42 > JET FUEL B= 20083                          < 43 > JET FUEL A= 17109
< 44 > STOVE OIL= 5913                            < 45 > LIGHT FUEL OIL= 13398
< 46 > DIESEL FUEL= 157016                        < 47 > HEAVY FUEL OIL= 24342
< 48 > RESID TO COKING= 0                         < 49 > REF C4 TO BLENDING = 12023.4
< 50 > ALKYLATE= 21420.3                          < 51 > CRUDE LIGHT ENDS= 3.12045
< 52 > TOTAL PRODUCT= 471507                      < 53 > C2 % IN CRUDE FEED= .10416
< 54 > C3 % IN CRUDE FEED= .07234                 < 55 > I-C4 % IN CRUDE FEED= .41795
< 56 > N-C4 % IN CRUDE FEED= 1.734                < 57 > LE FROM REFORMER (FOE)= 13575.5
< 58 > NAPHTHA= 14374                             < 59 > KEROSENE= 20903.2
< 60 > KEROSENE= 100662                           < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 20715.3                    < 63 > LE FROM ALKYL (FOE)= 2548.97
< 64 > HVGO= 137090                               < 65 > LGO = 11990.4
< 66 > NAPHTHA PETROCHEMICAL FEED= 377            < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                             < 69 > LSR= 31122.4
```

```
                         LIGHT ENDS BALANCE

                            *** FROM ***




              CRUDE UNIT   REFORMER   CAT CRACKER   POLY      ALKYL     ISO      TOTAL
C2  ,0/HR      2709.91     10603.5     42600.5      0         0         0        55913.9
C3  ,0/HR      32026.4     27937.1     31503.1      13441.1   15159.9   0        120068
IC4  ,0/HR     17065.3     16511.9     73746.8      33055.7   0         0        140380
NC4  ,0/HR     73313       24097.4     28348.4      11759.6   16240.2   0        153759
H2  ,0/HR      0           26733.3     17429.2      0         0         0        44162.5
C1  ,0/HR      0           10603.5     17663.6      0         0         0        28267.1
H2S  ,0/HR     0           0           3985.69      0         0         0        3985.69
C2=  ,0/HR     0           0           25975.9      0         0         0        25975.9
C3=  ,0/HR     0           0           73392.9      0         0         0        73392.9
C4=  ,0/HR     0           0           111164       0         0         0        111164
TOTAL  ,0/HR   125115      116487      425810       58256.4   31400.1   0        757068
BPCD (FOE)     10125.4     13575.4     36694.8      4702.11   2548.98   0        67646.7


                         *** TO ***
              POLY         ALKY        GAS BLEND    PC FEED   DOS       FUEL GAS  TOTAL
C2  ,0/HR      0           0           0            0         0         55913.9   55913.9
C3  .0/HR      10977.3     15159.9     0            0         0         93930.4   120068
IC4  ,0/HR     30592       106411      2649.64      0         0         727.11    140380
NC4  ,0/HR     11759.6     16240.2     98672.1      0         0         27086.6   153759
H2  ,0/HR      0           0           0            0         15151.8   29010.7   44162.5
C1  ,0/HR      0           0           0            0         0         28267.1   28267.1
H2S  ,0/HR     0           0           0            0         0         3985.69   3985.69
C2=  ,0/HR     0           0           0            0         0         25975.9   25975.9
C3=  ,0/HR     23747.2     32795.4     0            0         0         16850.3   73392.9
C4=  ,0/HR     46113.5     63683.7     1072.63      0         0         294.167   111164
TOTAL  ,0/HR   123190      234290      102394       0         15151.8   282042    757068
BPCD (FOE)     9815.93     18700.9     8244.16      0         3497.03   27388.7   67646.7
```

```
                         **** OVERALL MASS BALANCE ****
*** FEED ***


                         BPCD                     #/HR


CRUDE                     496124                   6.10068E+06
BUTANE                    1488.53                  12250.6
TOTAL                     497613                   6.11293E+06





*** PRODUCT ***


FUEL GAS (FOE)            27380.7                  282042
MOTOR GASOLINE            203230                   2.17045E+06
AVIATION TURBO FUELS      37992                    438515
DISTILLATES               177127                   2.22703E+06
HEAVY FUEL OIL            24342                    378756
OTHER PRODUCTS            28896                    404771
H2 TO DESULFURIZERS (FOE) 3497.83                  15151.8
COKE (FOE)                10463.5                  196460
TOTAL                     512928                   6.11317E+06
```

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TIME:01.48.39 DATE:SUNJUN101984162 66
REFINERY SIMULATION PROGRAM

CASE:WESBAS21 REGION:WESTERN

#### FEED BLEND ####

          CRUDE ORIGIN            LV %          BPCD

          CANDNL                  65.1          322079
          SYNCRUDE                31.5          155845
          CONDENSA                3.4           16821.4
           No.  MBP         LV %       S.G.        API          SULFUR WT%  BPCD          Lbs/hr FEED     Lbs/hr SULFUR
           Total            100                                              494746         6.08372E+06     18932.6
           Average                  .844146     36.1252      .311201

             #### MATERIAL BALANCE ####


          CRUDE UNIT
           No. Name           BPCD        Lbs/hr       IBP          EBP        S.G.         API             SULFUR WT%  Lbs/hr Su
                        ### FEED ###
           0   CRUDE FEED     494746      6.08372E+06  60           1240       .844145      36.1253         .311201     18932.6
                        ### PRODUCT ###
           2   OVERHEAD       49692.6     461217       60           171.04     .637153      90.5818         .014725     67.9141
           28  LSR            34214.7     336377       60           171.04     .674906      78.1500         .020189     67.9111
           3   NAPHTHA        86951.1     958859       171.04       323.921    .757024      55.4161         .0149314    143.171
           4   KEROSENE       127046      1.54242E+06  323.921      560        .833434      38.2795         .0627476    967.831
           5   LGO            56436.6     724267       560          660        .880983      29.116          .219173     1587.4
           1   REDUCED CRUDE  174619      2.39696E+06  660          1240       .942321      18.6611         .67445      16166.3


          VACUUM UNIT
           No. Name           BPCD        Lbs/hr       IBP          EBP        S.G.         API             SULFUR WT%  Lbs/hr Su
                        ### FEED ###
           32  REDUCED CRUDE  174619      2.39696E+06  660          1240       .942321      18.6611         .67445      16166.3
                        ### PRODUCT ###
           6   HVGO           142965      1.91455E+06  660          1050       .919318      22.4184         .412657     7900.5
           7   RESIDUUM       31653.8     482408       1050         1240       1.04621      3.75011         1.7133      8265.1


          CAT CRACKER
           No. Name           BPCD        Lbs/hr       IBP          EBP        S.G.         API             SULFUR WT%  Lbs/hr Su
                        ### FEED ###
           65  LGO            4986.8      63997        560          660        .880983      29.116          .219173     140.264
           64  HVGO           137493      1.84127E+06  660          1050       .919318      22.4184         .412657     7598.11
                        ### TOTAL FEED ###
           8   FCCU FEED      142480      1.90526E+06  560          1050       .917976      22.6435         .406158     7738.38
                        ### PRODUCT ###
           12  LCO            22796.8     322836       430          650        .972161      14.052          .701512     2264.73
           13  HCO            5699.2      89785.6      650          736.628    1.08149      -.661987        1.10039     995.174
           14  CRACKED GAS    80075.6     875636                               .750677      56.9965         .0406731    356.148
           39  C3/C4 -FCCU    35235.5     289494                               .564012      119.381         0           0
          ### PRODUCT ###
          < 10 > LE FROM CAT CRACKER (FOE)= 13241.7
          AVAILABLE C3/C4 OLEFINS= 35244.4
          CONVERSION Wt%= 78.3431    CONVERSION Vol %= 80
          COKE, WT% 10.3762
          COKE  ,0/HR 197796          Sulfur in Flue Gas,Lbs/hr= 413.735
```

```
CAT POLY UNIT
*** FEED ***
< 10 > CAT POLY FEED= 15000




*** PRODUCT ***
< 15 > POLYMER= 6115.17
< 16 > LE FROM POLY (FOE)= 4712.82


ALKYLATION UNIT
*** FEED ***
< 11 > ALKYLATION FEED= 29290
< 62 > C3/C4 TO ALKYL= 20235.5
< 20 > I-C4 FR. GAS PLANT= 7531.38
< 21 > I-C4 IMPORTED= 1523.13
*** PRODUCT ***
< 50 > ALKYLATE= 20899.2
< 63 > LE FROM ALKYL (FOE)= 2511.98


CATALYTIC REFORMER UNIT
  No. Name            BPCD        Lbs/hr        IBP         EBP         S.G.        API          SULFUR WT%  Lbs/hr Su
                 *** FEED ***
  9   REFORMER FEED 72200        796190        171.04      323.921     .757024   55.4161         0           0
                 *** PRODUCT ***
  17  REFORMATE     59418.6     696151                                  .804287   44.4322         0           0
*** PRODUCT ***
< 57 > LE FROM REFORMER (FOE)= 11501.9
CONVERSION(LV%)= 82.2972    Severity (RON Clear)= 96.5  FEED KW= 11.8127


GAS PLANT
*** FEED ***
< 2 > OVERHEAD= 49692.6
< 57 > LE FROM REFORMER (FOE)= 11501.9
< 18 > LE FROM CAT CRACKER (FOE)= 13241.7
< 16 > LE FROM POLY (FOE)= 4712.82
*** PRODUCT ***
< 19 > FUEL GAS (FOE)= 25149.4
< 20 > I-C4 FR. GAS PLANT= 7531.38
< 49 > REF C4 TO BLENDING = 11994.6
< 69 > LSR= 31700.0


ISOMERIZATION UNIT (ONCE THRU)
*** FEED ***
< 69 > LSR= 31700.0
*** PRODUCT ***
< 29 > LSR+ISO= 31700.0


*** BY-PASS= 100 %   ***
```

```
GASOLINE BLENDING
### FEED ###
< 29 > LSR+ISO= 31708.8
< 26 > REFORMATE= 52436.6
< 50 > ALKYLATE= 20899.2
< 15 > POLYMER= 6115.17
< 14 > CRACKED GAS= 80075.6
< 49 > REF C4 TO BLENDING = 11994.6
< 68 > IMPORTED C4= 0
### PRODUCT ###
< 22 > LEADED REGULAR= 20065
< 23 > UNLEADED REGULAR= 166685
< 24 > UNLEADED PREMIUM= 13901
< 25 > AVIATION GASOLINE= 2579




      ### GASOLINE COMPOSITION ###


                 LR            UR            UP            AV


LSR              .35043        .148048       0             0
CRACKED GAS      .198776       .45           .0776153      0
REFORMATE        .401572       .219212       .563968       0
POLYMER          0             .036687       0             0
ALKYLATE         0             .0852142      .3            .9786
C4               .0492225      .0608386      .0584166      .0214


      TURBO FUEL BLENDING
      ### FEED ###
      < 30 > LSR= 2505.96
      < 58 > NAPHTHA= 14374
      < 59 > KEROSENE= 21112
      ### PRODUCT ###
      < 42 > JET FUEL B= 20883
      < 43 > JET FUEL A= 17109


      ### TURBO FUEL COMPOSITION ###


                     NAPHTHA BASE  KEROSENE BASE


      LSR            .12           0
      NAPHTHA        .59           .12
      KEROSENE       .29           .88
```

```
DISTILLATE BLENDING
*** FEED ***
< 60 > KEROSENE= 105934
< 40 > LGO= 50985.8
< 38 > LCO= 20206.8
*** PRODUCT ***
< 44 > STOVE OIL= 5913
< 45 > LIGHT FUEL OIL= 13390
< 46 > DIESEL FUEL= 157816


*** DISTILLATE COMPOSITION ***


                STOVE OIL     DIESEL FUEL   LFO


KEROSENE        1             .63           .0445000
LCO             0             .1            .330200
LGO             0             .27           .625131


HEAVY FUEL OIL BLENDING
*** FEED ***
< 41 > LGO= 464.003
< 35 > LCO= 2590
< 13 > HCO= 5699.2
< 37 > HVGO= 0
< 31 > REDUCED CRUDE= 0
< 34 > VAC RESIDUUM= 15588.8
*** PRODUCT ***
< 47 > HEAVY FUEL OIL= 24342









             OTHER PRODUCTS
< 27 > NAPHTHA SPECIALTIES= 6982
< 36 > HVGO TO LUBE OIL= 5472
< 48 > RESID TO COKING= 0
< 33 > VAC RESID TO ASPHALT PLANT= 16065
< 61 > OLEFIN PETROCHEMICAL FEED= 0
< 66 > NAPHTHA PETROCHEMICAL FEED= 377
< 67 > VGO PETROCHEMICAL FEED= 0

DISTILLATE DESULFURIZATION


        STREAM           TOTAL                   FEED  TO  DDS                                         FINAL STREAM
                          BPCD       BPCD       Lbs/hr      SULFUR WT%                   % BYPASS      SULFUR WT%
        KEROSENE         127046      127046     1.54242E+06  .0627476                     0             3.13925E-03
        LGO              51449.8     51449.8    660278       .219173                      0             .0219606
        LCO              22796.8     11398.4    161410       .701512                      50            .387053
        HCO              5699.2      0          0            1.10839                      100           1.10839
        VAC RESIDUUM     15588.8     0          0            1.7133                       100           1.7133
```

```
***PRODUCT SLATES & SPECIFICATIONS***

                  JET FUEL B   JET FUEL A    STOVE OIL     LFO           DIESEL FUEL   HFO

BPCD              20883        17109         5913          13398         157816        24342
S.G.              .769329      .824265       .833434       .908978       .860145       1.04344
ASTM 10%          205.002      342.441       388.134       507.878       402.791
ASTM 20%          224.516      368.197       402.306       542.228       429.779
ASTM 50%          277.878      432.846       448.885       590.66        504.574
ASTM 90%          471.958      517.081       519.8         625.739       607.354
RVP,psia          2.39383
Sulfur Wt %       .0117796     4.43721E-03   3.13738E-03   .149701       .051584       1.40769
Flash Point,F     63.3984      132.379       146.399       213.232       154.254
Pour Point,F      -96.4694     -50.2323      -43.3879      -18.9906      -32.8446
Cetane No.                                                               42.4668
Visc @100F,cs     .783705      1.61501       1.84423       4.93206       2.56878       1435.35
Visc @122F,cs     .690917      1.37706       1.56099       3.88126       2.12847       523.066
Watsons K         11.7925      11.6406       11.6065       11.1332       11.4468       10.7516
MeABP             286.713      423.355       445.139       576.4         494.492       952.07

GASOLINE

          LEADED REGULAR,BPCD              20065
          TEL Addition,cc/IG: 1.24
          RON / MON / (R+M)/2 (Clear)      88.5954 / 80.7836 / 84.6895
          RON / MON / (R+M)/2              93.8905 / 85.6688 / 89.7797
          RVP,psia                         10.5314


          MMT Addition,mg/l: 18
          UNLEADED REGULAR,BPCD            166685
          RON / MON / (R+M)/2              93.634 / 84.5859 / 89.11
          RVP,psia                         10.1193


          UNLEADED PREMIUM,BPCD            13901
          RON / MON / (R+M)/2              96.1298 / 87.8493 / 91.9895
          RVP,psia                         9.74624




          AVIATION GASOLINE,BPCD           2579
          RON / MON / (R+M)/2              93 / 90.8 / 91.9
          RVP,psia                         10
```

```
                    STREAMS

< 0 > CRUDE FEED= 494746                  < 1 > REDUCED CRUDE= 174619
< 2 > OVERHEAD= 49692.6                   < 3 > NAPHTHA= 86951.1
< 4 > KEROSENE= 127046                    < 5 > LGO= 56436.6
< 6 > HVGO= 142965                        < 7 > RESIDUUM= 31653.8
< 8 > FCCU FEED= 142480                   < 9 > REFORMER FEED= 72200
< 10 > CAT POLY FEED= 15000               < 11 > ALKYLATION FEED= 29290
< 12 > LCO= 22796.8                       < 13 > HCO= 5699.2
< 14 > CRACKED GAS= 80075.6               < 15 > POLYMER= 6115.17
< 16 > LE FROM POLY (FOE)= 4712.82        < 17 > REFORMATE= 59418.6
< 18 > LE FROM CAT CRACKER (FOE)= 13241.7 < 19 > FUEL GAS (FOE)= 25149.4
< 20 > I-C4 FR. GAS PLANT= 7531.38        < 21 > I-C4 IMPORTED= 1523.13
< 22 > LEADED REGULAR= 20065              < 23 > UNLEADED REGULAR= 166685
< 24 > UNLEADED PREMIUM= 13901            < 25 > AVIATION GASOLINE= 2579
< 26 > REFORMATE= 52436.6                 < 27 > NAPHTHA SPECIALTIES= 6982
< 28 > LSR= 34214.7                       < 29 > LSR+ISO= 31700.8
< 30 > LSR= 2505.96                       < 31 > REDUCED CRUDE= 0
< 32 > REDUCED CRUDE= 174619              < 33 > VAC RESID TO ASPHALT PLANT= 16065
< 34 > VAC RESIDUUM= 15588.8              < 35 > LCO= 2590
< 36 > HVGO TO LUBE OIL= 5472             < 37 > HVGO= 0
< 38 > LCO= 20206.8                       < 39 > C3/C4 -FCCU= 35235.5
< 40 > LGO= 50985.8                       < 41 > LGO= 464.003
< 42 > JET FUEL B= 20883                  < 43 > JET FUEL A= 17109
< 44 > STOVE OIL= 5913                    < 45 > LIGHT FUEL OIL= 13398
< 46 > DIESEL FUEL= 157816                < 47 > HEAVY FUEL OIL= 24342
< 48 > RESID TO COKING= 0                 < 49 > REF.C4 TO BLENDING = 11994.6
< 50 > ALKYLATE= 20899.2                  < 51 > CRUDE LIGHT ENDS= 3.12845
< 52 > TOTAL PRODUCT= 471587              < 53 > C2 % IN CRUDE FEED= .10416
< 54 > C3 % IN CRUDE FEED= .87234         < 55 > I-C4 % IN CRUDE FEED= .41795
< 56 > N-C4 % IN CRUDE FEED= 1.734        < 57 > LE FROM REFORMER (FOE)= 11501.9
< 58 > NAPHTHA= 14374                     < 59 > KEROSENE= 21112
< 60 > KEROSENE= 105934                   < 61 > OLEFIN PETROCHEMICAL FEED= 0
< 62 > C3/C4 TO ALKYL= 20235.5            < 63 > LE FROM ALKYL (FOE)= 2511.98
< 64 > HVGO= 137493                       < 65 > LGO = 4986.8
< 66 > NAPHTHA PETROCHEMICAL FEED= 377    < 67 > VGO PETROCHEMICAL FEED= 0
< 68 > IMPORTED C4= 0                     < 69\> LSR= 31700.8
```

```
                              LIGHT ENDS BALANCE

                                 *** FROM ***



                CRUDE UNIT   REFORMER    CAT CRACKER  POLY        ALKYL       ISO         TOTAL
C2  ,#/HR        2702.38      8537.46     43393.5     0           0           0           54633.3
C3  ,#/HR        31937.4      23548.2     30903.1     13512.7     14904.1     0           114806
IC4  ,#/HR       17017.9      15224.9     71710.3     32904.6     0           0           136938
NC4  ,#/HR       73109.3      22219.2     27938.5     11890.6     16040.9     0           151199
H2  ,#/HR        0            21972.2     17760.7     0           0           0           39732.9
C1  ,#/HR        0            8537.46     17992.4     0           0           0           26529.9
H2S  ,#/HR       0            0           3940.37     0           0           0           3940.37
C2=  ,#/HR       0            0           26459.5     0           0           0           26459.5
C3=  ,#/HR       0            0           70319.6     0           0           0           70319.6
C4=  ,#/HR       0            0           109110      0           0           0           109110
TOTAL  ,#/HR     124767       100039      419528      58307.9     30945       0           733667
BPCD (FOE)       10097.3      11501.9     36255.9     4712.81     2511.98     0           65079.9


                                 *** TO ***
                POLY          ALKY        GAS BLEND   PC FEED     DDS         FUEL GAS    TOTAL
C2  ,#/HR        0            0           0           0           0           54633.3     54633.3
C3  ,#/HR        11048        14904.1     0           0           0           88853.5     114806
IC4  ,#/HR       30519.9      103156      2632.5      0           0           629.75      136938
NC4  ,#/HR       11890.6      16040.8     99470.5     0           0           23796.6     151199
H2  ,#/HR        0            0           0           0           15861.9     23871       39732.9
C1  ,#/HR        0            0           0           0           0           26529.9     26529.9
H2S  ,#/HR       0            0           0           0           0           3940.37     3940.37
C2=  ,#/HR       0            0           0           0           0           26459.5     26459.5
C3=  ,#/HR       23343.8      31491.6     0           0           0           15484.1     70319.6
C4=  ,#/HR       46437.2      62645.3     22.229      0           0           5.31397     109110
TOTAL  ,#/HR     123239       228237      102125      0           15861.9     264203      733667
BPCD (FOE)       9819.84      18225.2     8224.52     0           3660.93     25149.4     65079.9
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```
                                **** OVERALL MASS BALANCE ****
*** FEED ***


                                BPCD                      #/HR


CRUDE                            494746                    6.08372E+06
BUTANE                           1523.13                   12535.4
TOTAL                            496269                    6.09626E+06




*** PRODUCT ***


FUEL GAS (FOE)                   25149.4                   264203
MOTOR GASOLINE                   203230                    2.17853E+06
AVIATION TURBO FUELS             37992                     439461
DISTILLATES                      177127                    2.22658E+06
HEAVY FUEL OIL                   24342                     369993
OTHER PRODUCTS                   29896                     404071
H2 TO DESULFURIZERS (FOE)        3660.93                   15861.9
COKE (FOE)                       10534.6                   197796
TOTAL                            510932                    6.0965E+06
```

"E"

REVISED 16 MARCH 1984
47SS KE145-3-0745
OSS83-00188

STATEMENT OF WORK

Objective: To identify the costs to the petroleum refining industry associated with the removal of MMT (methylcyclopendadienyl manganese tricarbonyl) from gasoline for the year 1990.

Statement of Work:

1) Describe options for the oil refining industry to boost octane without the use of MMT by providing an overview of other additives ([i.e.] methanol) but more specifically by reviewing the alternatives in refinery processing.

2) Identify the capital and operating costs (in 1983 dollars) associated with MMT removal from lead-free gas, assuming the following cases of allowable lead concentrations:

   a) 0.29 g/litre
   b) 0.15 g/litre
   c) 0.0 g/litre

3) Revise model to reflect projected 1990 operations. The projected operations which include product demand, crude supply, refinery processing facilities, etc. will be supplied by EMR from a recently completed study.

4) For each grade of gasoline, analysis will be carried out at two octane levels:

   . minimum RON as per CGSB spec
   . current RON in the market place

5) Constraints to be considered include:

   (a) utilization of the CGSB specification of 18 mg/l. of manganese;
   (b) minimization of operating costs (especially crude oil usage) but describing other capital and operating cost options;
   (c) recognition of regional differences in production where they exist.

6) Discuss in a qualitative sense the cost implication if refineries are limited to one half of the CGSB specification (i.e.) .09 mg/l of manganese.

7) Prepare a draft report in 10 copies by April 15, 1984.

8) Prepare a final report in 25 copies by May 30, 1984.

MINUTES OF MEETING

Location: Place Vincent Massey, Hull, Quebec.

Date: March 14, 1984.

Time: 10:00 a.m.

Present:

Mr. Art Stelzig	EPS	Mr. Hap Lafferty	Monenco
Mr. Joe Labuda	EPS	Mr. Alan O'Brien	Monenco
Mr. Vic Shantora	EPS	Mr. Greg Bourque	Esso
Mr. Fritz Landheer	DOE	Mr. Salil Ray	Gulf
Mr. Jack King	EMR		
Mr. Kim Smith	EMR		
Mr. Dave Black	EMR		

1. Introductory remarks by Vic Shantora and Art Stelzig reviewed the need for the study and the schedule for final submission to the Committee.

2. Monenco presented the approach to the study and reviewed the scope of work and assumptions made.

3. Industry representatives said that the main area of their concern was that the study would miss the mark with respect to the capital cost effect on the refining industry of changing emission standards. However, in view of the regional approach of the model and the study budget, the results would likely reflect the broad base numbers sought for discussion purposes.

   Various scenarios were discussed but the two areas of the study that were felt to be deficient were:

   Using RON as the only octane criteria for the study. It was felt that the R+M/2 specification should be reported.

   Cases under Investigation. Messrs. Bourque and Ray felt the cases under investigation did not accurately reflect the effect on the refining industry of changing emission standards.

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4. Other areas of concern were:

(a) The industry octane numbers (RON) being used for the study were questioned. Monenco replied that the numbers were derived from a survey of refinery operations and were fixed at one value for simplicity in the regional refinery approach to the study. It was agreed that for the purpose of the study, these numbers would be used.

(b) The installed reformer capacities used in the study were considered conservative because of the number of old units in Canada that could not be operated at higher severities. It was decided that industry would provide the capacities to be used in the study by Monday, March 19 . Failing that, the study was to proceed on the original basis.

(c) Industry representatives questioned the approach of including hydrocracking capacity with catalytic cracking. Monenco are aware of the problem and are taking action to rectify it.

(d) The approach to capital costs was discussed. Monenco stated that once the additional process unit capacities were identified for each region, capital costs would be developed based on in-house expertise and data plus consultation with licensors and suppliers of major equipment.

5. Monenco were asked by EPS to amend the scope of the study as follows.

1. The following two cases to be studied for each region at the industry octane levels and the government octane levels.

Base:	1990	.29 g/L lead and 18 mg/L Mg	70% unleaded 30% leaded
Case:	1990	.29 g/L lead and 0 MMT	90% unleaded 10% leaded

(This gives a study total of 16 simulations.)

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2. Octane criteria to include RON and R+M/2.

Monenco stated that the changes to scope would incur a penalty to the schedule of two weeks provided all outstanding information was received by Monday, March 19. Monenco confirmed that changes to the scope would not affect the final cost.

Messrs. Ray and Bourque will provide the following information by Monday, March 19:

1. Industry values for R+M/2.
2. Installed reformer capacities and limitations on operation.

AO'B/dm

COPY: All present
M.J. Rowsell
J. Scott

Environment Canada Environnement Canada

Contractors Inc.,
Suite 400,
2 St. Claire Avenue East,
Toronto, Ontario
M4T 2J5
Attn: H. Lafferty

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JUN 19 1984
MANAGER
EASTERN DIVISION

CONTRACT FOR SERVICE OR WORK **CONTRAT POUR SERVICE OU TRAVAUX**

CORRESPONDENCE AND INVOICES MUST SHOW THESE NUMBERS
Numéros à indiquer sur lettres et factures

Contract No. Numéro du Contrat
KE145-4-0162

RESP. CENTER Cent. de resp.	PROG. ACT. Prog./Act.	COST CODE Code du coût	AUTHORITY Autorité	LINE OBJECT Art. d'exéc.
1330	1330	00201	101	1160

GENERAL DESCRIPTION OF WORK OR SERVICE - Description général des travaux ou service

Identify cost of gasoline grade split change to refineries.

I/We hereby offer to supply the materials and perform the work or service referred to hereunder on the convenents and agreements contained hereunder on the attached general terms and conditions sheet.

Par les présentes j'offre (nous offrons) de fournir le matériel et d'exécuter les travaux ou les services mentionnés ci-dessous conformément aux stipulations indiquées aux termes et conditions ci-dessous.

DUTIES:

Provide a report which identifies the capital and operating costs to petroleum refineries as a result of a change in the gasoline grade split as identified in the attached Terms of Reference.